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VOL. VI.

BEES.

COMPREHENDING THE USES AND ECONOMICAL MANAGEMENT OF THE

HONEY-BEE

OF BRITAIN AND OTHER COUNTRIES, TOGETHER WITH DESCRIPTIONS OF THE KNOWN WILD SPECIES.

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THE

NATURAL HISTORY

OF

BEES.

COMPREHENDING THE USES AND ECONOMICAL MANAGEMENT
OF THE BRITISH AND FOREIGN
HONEY-BEE;
TOGETHER WITH THE KNOWN WILD SPECIES,

ILLUSTRATED BY THIRTY-SIX PLATES COLOURED FROM NATURE,
WITH PORTRAIT AND MEMOIR OF HUBER.

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FROM THE PUBLISHER.

From the commencement of this Work it has been our uniform anxiety to adorn it with as much of pictorial beauty and interest as possible, and the present, although, at first appearance, embracing a subject not very favourable for such displays, will, we trust, be esteemed as not the least attractive in this respect,—while the absorbing interest of its literary details are probably second to none of the series. For the latter we are indebted to a reverend friend well known as one of the keenest observers, and most successful cultivators of the community of the tiny beings which form the subject before us. To our friend Mr. Duncan, the contributor of our Entomological volumes, the best acknowledgments are due for the extension of the subject in his interesting details of the Foreign and

Wild species; and for the admirable manner in which he has conducted the volume through the press. He has availed himself of the invaluable assistance of Mr. Westwood for drawings and descriptions of various figures, which now, in some cases, appear before the public for the first time. Upon the whole, we hope it will be found that the present is an interesting volume in all its details; and, though last, not least in its attractions, in our having been enabled to enrich it with the only portrait of Huber known to have been published; and for which we are indebted to the Sister of the amiable person represented.

Our next will be the second volume on the Dog, by Colonel H. Smith, and will contain an account of the domestic races and varieties, together with the different species of the Fox and Hyæna.

3, St. James' Square,
Edinburgh, 1840.

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MEMOIR OF HUBER.

THE Naturalist whose researches have been specially directed to the instinct and operations of the domestic Honey-Bee, will be strongly disposed to regard the subject of this memoir as at the very head of Apiarian science, and his writings as forming the safest and most useful text-book. Multitudes have written on this interesting department of Natural History, and have added more or less to our knowledge of what has been a subject of investigation for ages. But none, either in ancient or modern times, have displayed so much sagacity of research as Francis Huber, nor so much patient perseverance and accuracy of experiment, even admitting some errors of minor importance detected by succeeding observers. His success in discovery, notwithstanding the singular difficulty he had to struggle with, was proportioned to his intelligence and acuteness; and this difficulty arose, not from what some of his advocates have, in their zeal in his defence against the sneers of the sceptical, termed "imperfect vision," but from *total blindness*. For, from the period when he first applied

himself in good earnest to investigate the nature of his winged favourites, external nature presented to his eyes one universal blank;

"So thick a drop serene had quenched their orbs."

It is not, therefore, without reason that his friend and eulogist De Candolle* asserts that "nothing of any importance has been added to the history of bees since his time; and naturalists of unimpaired vision have nothing of consequence to subjoin to the observations of a brother who was deprived of sight."

Francis Huber was born at Geneva on the 2d July, 1750. His father possessed a decided taste for subjects of natural science; the son inherited the taste of his father; and, even in his boyish days, pursued his favourite studies with such intense ardour as materially to injure his health, and bring on that weakness in his visual organs which eventually ended in total blindness. His attention had been led to what became his favourite,—indeed his sole and engrossing study, the habits and economy of the Honey-Bee, by his admiration of the writings of Reaumur, and above all, by his acquaintance with Bonnet,—the illustrious author of "Contemplation de la Nature," who quickly discerned the intelligence and penetration of his young friend, and who kindly and strongly encouraged him in his peculiar researches. It is singular enough that these two distinguished naturalists and friends

* See Memoir of Huber by M. de Candolle in the Edinburgh Philosophical Journal for April 1833.

should both have laboured under a similar personal defect, occasioned, too, by the same causes; for the same intenseness and minuteness of observation which deprived Huber of sight altogether, had brought on in Bonnet a weakness of vision which for a time threatened total blindness, and from which he never fully recovered.

It will readily occur to every one that the loss of sight in Huber must not only have presented a very serious obstacle to the successful study of his favourite science, but must have had the effect also of throwing considerable doubt on the accuracy of his experiments and the reality of his discoveries. His most devoted admirers and most unhesitating followers in every thing connected with the economy of Bees, are bound in candour to acknowledge, that his observations, reported, as they were, at second hand, and depending for their accuracy on the intelligence and fidelity of a half-educated assistant, were, of themselves, not entitled to be received without caution and distrust. Francis Burnens, his assistant, had no doubt entered with enthusiasm into the pursuit, and appears to have conducted the experiments not only with the most patient assiduity, but with great address and no small share of steadiness and courage, qualities indispensable in those who take liberties with the *irritabile genus apum*. Still Burnens was but an uncultivated peasant when he became Huber's hired servant, and possessed none of those acquired accomplishments which serve to sharpen the intellectual faculties, and fit the mind for observing and discriminating with correctness.

It cannot reasonably excite our wonder, therefore, that on the first appearance of Huber's observations, the literary, or rather the scientific world, was somewhat startled, not only at the novelty of his discoveries, but also at the instrumentality by which they had been effected. Huber, however, had taken great pains in cultivating the naturally acute mind of the young man, in directing his researches, and accustoming him to rigorous accuracy in his observations. And the fact that a glimmering of many of the discoveries reported by the assistant to his master had presented themselves to the minds of Linnæus, Reaumur, and other preceding observers, should so far satisfy us that they were not brought forward merely to support a preconceived theory, (of which, it is probable, Burnens had no idea,) nor owed their origin to a vivid and exuberant imagination. At a future period Huber was deprived of the aid of this valuable coadjutor; but the loss was more than compensated, and accuracy in experiment and observation, if possible, still more unquestionably secured, by the assistance and co-operation of his son, P. Huber, who has given so much delight to the lovers of natural history by his "Researches concerning the habits of Ants."

But, whatever hesitation may arise in our minds from the fact of Huber's discoveries not being the result of his personal observation, no doubt can reasonably remain as to such of them as have been repeatedly confirmed and verified by subsequent observers. And this has actually taken place, and holds

strictly true in regard to the most important of them. His discoveries respecting the impregnation of the Queen-Bee,—the consequences of retarded impregnation,—the power possessed by the working-bees of converting a worker-larva into a Queen,—a fact, though not originally discovered by Huber, yet, until his decisive experiments and illustrations, never entirely known or credited,—the origin of Wax, and the manner of its elaboration,—the nature of Propolis,—the mode of constructing the combs and cells,—and of ventilating or renovating the vitiated atmosphere of the hives,—these, and a variety of other particulars of inferior moment, have almost all been repeatedly verified by succeeding observers, and many of them by the writer of this brief Memoir. It is readily admitted, that some of his experiments, when repeated, have not been attended by the results which he led us to expect; and some incidents in the proceedings of the Bees stated as having been observed by him or his assistant, have *not yet* been witnessed by succeeding observers. But in some of these, the error may have been in the repetition; in others, the result, even under circumstances apparently the same, may not always be uniform, for the instinct of Bees is liable to modification; and in some, he doubtless *may be,* and probably *is,* mistaken. In passing judgment, however, on his reported discoveries, we ought to keep in view, that the author of them has thrown more light on this portion of natural history, and pursued it with a more assiduous and minute accuracy, than all the other naturalists taken

together, who have turned their attention to the same pursuits; and that therefore nothing short of the direct evidence of our senses, the most rigid scrutiny, and the most minute correctness of detail in experiment, can justify our denouncing his accuracy, or drawing different conclusions. His experiments were admirably fitted to elicit the truth, and his inferences so strictly logical, as to afford all reasonable security against any very important error.

Huber's "Nouvelles observations sur les Abeilles", addressed in the form of letters to his friend Bonnet, appeared in 1792 in one volume. In 1814, a second edition was published at Paris in two volumes, comprehending the result of additional researches on the same subject, edited in part by his son. An English version appeared in 1806, and was very favourably noticed by the Edinburgh Review. A third edition of this translation was published in Edinburgh in 1821, embracing not only the original work of 1792, but also the several additions contained in that of 1814, and which had originally made their appearance in the Bibliothèque Britannique. These additional observations were, On the Origin of Wax, On the use of Farina or Pollen, On the Architecture of Bees, and On the precautions adopted by these insects against the ravages of the Sphinx Atropos.

To enlarge on the personal character and domestic circumstances of Huber, falls not strictly within our province, which embraces only, or chiefly, his character and writings as a naturalist. There are however some features in his disposition, and some cir-

cumstances in his personal history, dwelt upon at considerable length by De Candolle,* which appear so well worthy the attention of our readers, that we cannot forego the opportunity of detailing them, though necessarily in an abridged form. His manners were remarkably mild and amiable,—as is frequently found to be the case with those who are afflicted with blindness,—and his conversation animated and interesting. "When any one," says his friend, "spoke to him on subjects which interested his heart, his noble figure became strikingly animated, and the vivacity of his countenance seemed by a mysterious magic to animate even his eyes, which had so long been condemned to blindness." It appears that some of his friends would gladly have persuaded him to try the effect of an operation on *one* of his eyes, which seemed to be affected only by simple cataract; but he declined the proposal, and bore not only without complaint, but with habitual cheerfulness, his sad deprivation. His marriage with Maria Aimée Lullin, the daughter of a Swiss magistrate, was in a high degree romantic. The attachment had begun in their early youth, but was opposed by the lady's father on the ground of Huber's increasing infirmity; for even then, the gradual decay of his organs of vision was become but too manifest. The affection and devotedness of the young lady, however, appeared to strengthen in proportion to the helplessness of their object. She declared to her parents, that

* See Edinburgh Phil. Journal for April 1833.

although she would have readily submitted to their will, if the man of her choice could have done without her; yet as he now required the constant attendance of a person who loved him, nothing should prevent her from becoming his wife. Accordingly, as soon as she had attained the age which she imagined gave her a right to decide for herself, she, after refusing many brilliant offers, united her fate with that of Huber. The union was a happy one. Their mutual good conduct soon brought about the pardon of their disobedience. In the affection and society of his amiable and generous minded wife, the blind man felt no want; she was "eyes to the blind,"—"his reader,—his secretary and observer,"—a sharer in his enthusiasm on the subject of natural science, and an able assistant in his experiments. She was spared to him forty years. "As long as she lived," said he in his old age, "I was not sensible of the misfortune of being blind." The last years of his life were soothed by the affectionate attentions of his married daughter, Madame de Molin,* whose residence was at Lausanne, and to which place he had removed.

It was about this period that he learned the existence in Mexico of Bees without stings; and he was, by the kind exertions of a friend, soon after gratified with the present of a hive of that species.

* We have to express our acknowledgments to this lady for her ready kindness in permitting a friend in Geneva to have a copy taken of the very interesting miniature likeness of her venerable father in her possession, and which forms the Frontispiece to this volume.

To him, whose life had been almost exclusively devoted to the study and admiration of these insects, we may conceive how great a source of enjoyment this gift must have proved. His feeling towards his bees was not a feeling of fondness in an ordinary degree; it was a *passion,* as it almost invariably becomes with every one who makes them his study. "Beaucoup de gens aiment les abeilles," says the enthusiastic Gelieu, "je n'ai vu personne qui les aima *médiocrement;* on se *passionne* pour elles."

The days of Huber were now drawing to a close. In the full possession of his mental faculties, he was able to converse with his friends with his accustomed ease and tranquillity, and even to correspond by letter with those at a distance, within two days of his death. He died in the arms of his daughter on the 22d of December 1831, in the 81st year of his age.

THE HONEY-BEE.

APIS MELLIFICA. PLATE I.

INTRODUCTION.

The domestic Honey-Bee has excited a lively and almost universal interest from the earliest ages. The philosopher and the poet have each delighted in the study of an insect whose nature and habits afford such ample scope for inquiry and contemplation; and even the less intellectual peasant, while not insensible of the profit arising from its judicious culture, has regarded, with pleasure and admiration, its ingenious operations and unceasing activity. "Wise in their government," observes the venerable Kirby, "diligent and active in their employments, devoted to their young and to their queen, the Bees read a lecture to mankind that exemplifies their oriental name Deburah, *she that speaketh.*"

So high did the ancients carry their admiration of this tiny portion of animated nature, that one philosopher, it is said, made it the sole object of his study for nearly three-score years; another retired to the woods, and devoted to its contemplation the whole of his life; while the great Latin poet, the

enthusiastic Virgil, stating, and probably adopting, a prevalent opinion, speaks of the Bee as "having received a direct emanation from the divine intelligence." After all this study, however, these enthusiastic admirers have thrown but little light on the real nature of this extraordinary insect; and while they have handed down to us many judicious precepts for its practical treatment, their disquisitions on its natural history can now only excite a smile. The chief cause of this failure may be fairly ascribed, perhaps, to the want of those facilities for discovery which modern science has afforded, and by which the most hidden mysteries of Bee economy are rendered clear and palpable. A host of writers on the nature of the Bee appeared during the last century, who, availing themselves of the improvements in general science, made many interesting additions to our stock of knowledge on the subject. Swammerdam, Maraldi, Reaumur, Bonnet, Schirach, and more recently Huber on the Continent, and Thorley, Wildman, Keys, Hunter, and Bonner, among ourselves, multiplied, a hundred-fold, the discoveries of Aristotle, Columella, and Varo; and the vague conjectures and fabulous details of the latter philosophers, have been succeeded by rational research and discriminating experiment. But even in the investigations of the first named writers, not excepting the most accurate and successful experimenter of them all, the indefatigable Huber, there are some obvious errors which longer experience and observation have been enabled to detect, and some questionable state-

ments which can be attributed only to a want of cool and dispassionate inquiry. In fact, much has been written and published on the subject calculated to startle a sober reader; and some of those discoveries which have been blazoned in publications, both at home and abroad—though most frequently, perhaps, on the Continent—will be found, on strict examination, to have no existence but in the warm fancy or blind enthusiasm of the observers. The incontrovertible facts in the natural history of the Bee, are, in themselves, too remarkable to justify any attempt to draw upon the imagination for additional wonder; and the Naturalist who is desirous of making himself thoroughly acquainted with the instincts and habits of this interesting little creature, should be cautious in considering, as an established fact, any discovery, or supposed discovery, which has not been, again and again, verified by rigid experiment.

In the following details, embracing the Natural History and Practical Management of the Honey-Bee, we have endeavoured to avoid this error, stating nothing as fact, but what we know to be so from undoubted testimony, or from our own knowledge and experience. At the same time, we have not omitted to notice such alleged discoveries or results of experiments, as appear to us to be unsupported by sufficient evidence, or at variance with experiments of our own, made for the express purpose of verification, leaving it to the reader to receive or reject them as his judgment may dictate. We have

availed ourselves of the information dispersed throughout a variety of publications, both ancient and modern,* with such additions of our own, as have been acquired by the observation of Bees for a period of thirty years. Our prescribed limits have restricted us, in a great degree, to mere matters of fact, and prevented us often from illustrating our subject, as we might have done with advantage, by reference to the habits and instincts of other of the insect tribes. The same cause has operated as a bar to our indulging so frequently as our inclination would have led us, in those reflections which the wonders in animal economy are so well fitted to excite, and which lead so irresistibly to the conclusion that there is a Wise and Designing Cause. We trust, however, that the facts detailed, will, of themselves, lead the mind of the intelligent reader to such reflections, and thus become the source of a purer gratification than would have been derived from the suggestions of others.

* We have to acknowledge our special obligations to the Treatises of M. Feburier of Paris, and of Dr. Bevan of South Wales, Author of "The Honey-Bee."

** Some of our readers may be inclined to question the propriety of having placed the Queen-bee upon flowers, on which she is never seen, but it has, throughout our plates, been our endeavour to make them pictorial as well as scientifically correct, the more necessary in a volume such as the present, where our materials are rather scanty, a loss, however, fully compensated by the extraordinary interest in the subject itself.

ON THE ANATOMY OF THE HONEY-BEE.

THE Honey-Bee, *Apis mellifica*, is of the order *Hymenoptera*, or that of insects having four membranaceous wings. Its anatomic structure presents, even to the superficial observer, striking evidences of design in the All-wise Contriver, and of the admirable adaptation of its parts to their several uses.

The body of the insect is about half an inch long, of a blackish-brown colour which deepens with age, and is wholly covered with close-set hairs, which assist greatly in collecting the farina of flowers. (Wood-cut, Fig. 2.)

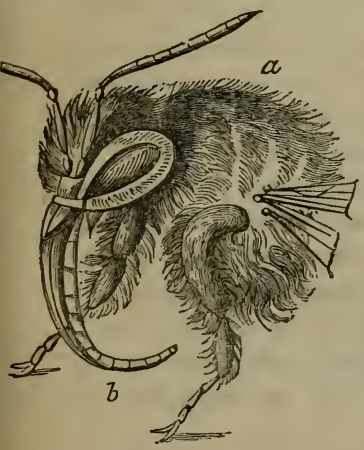


Fig. 2.

Fig. 1.

Tearing open the anthers of the plant on which it has alighted, and rolling its little body in the bottom of the corolla, the insect rapidly brushes off the farina, moistens it with its mouth, and passes it from one pair of legs to another, till it is safely lodged in the form of a kidney-shaped pellet in a spoon-like receptacle in its thigh to be afterwards noticed. These hairs deserve to be particularly remarked on account of their peculiar formation, being *feather-shaped*, or rather consisting each of a stem with branches disposed around it, and, therefore, besides their more effectually retaining the animal heat, peculiarly adapted for their office of sweeping off the farina.

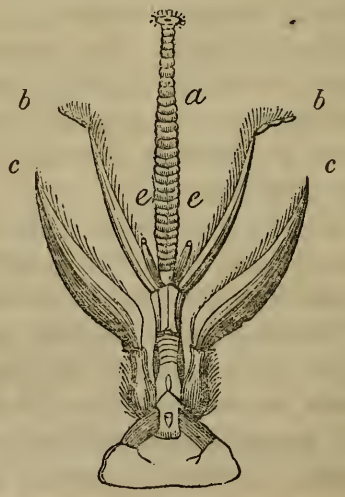
The HEAD, which is of a triangular shape and much flattened, is furnished with a pair of large eyes, (Woodcut, p. 31, Fig. 1, *a a*,) of what is called by naturalists the *composite* construction, and consisting of a vast assemblage of small hexagonal surfaces, disposed with exquisite regularity, each constituting in itself a perfect eye; they are thickly studded with hairs, which preserve them from dust, &c. In addition to these means of vision, the bee is provided with three small *stemmata*, or coronetted eyes, situated in the very crown of the head, and arranged in the form of a triangle. These must add considerably to the capacity of vision in an insect whose most important operations are carried on in deep obscurity. As to the special or peculiar use these *ocelli* may serve, Reaumur and Blumenbach were of opinion, that, while the large compound organs are used for viewing distant objects, the simple ones are employed on

objects close at hand. It is not improbable, however, that these last, from their peculiar position, are appropriated to upward vision.

The ANTENNÆ (Fig. I. *b*.) present us with another remarkable appendage of the head. These are two tubes about the thickness of a hair, springing from between the eyes, and a little below the ocelli; they are jointed throughout their whole length, each consisting of twelve articulations, and therefore capable of every variety of flexure. Their extremities are tipped with small round knobs, exquisitely sensible; and which, from their resemblance to the stemmata or ocelli, have been supposed by some to serve as organs of vision; by others, as connected with the sense of hearing; and by others, as organs of feeling or touch. This last seems the most probable conjecture, as on approaching any solid object or obstacle, the Bee cautiously brings its antennæ in contact with it, as if exploring its nature. The insects use these organs, also, as a means of recognizing one another; and an interesting instance is stated by Huber, in which they were employed to ascertain the presence of their queen, (vide page 48.)

The MOUTH of the Bee comprehends the tongue, the mandibles or upper jaws, the maxillæ or lower jaws, the labrum or upper lip, the labium or lower lip, with the proboscis connected with it, and four palpi or feelers. The *tongue* of the Bee, like that of other animals, is situated within the mouth, and is so small and insignificant in its form, as not to be easily discernible. In most anatomical descriptions

of the Bee, the real tongue, now described, has been erroneously confounded with the ligula or central piece of the proboscis, afterwards to be described. The *upper jaw* (Wood-Cut, page 31, fig. 1. *c, c.*) of the Bee, as of all other insects, is divided vertically into two, thus forming, in fact, a *pair* of jaws under the name of mandibles. They move horizontally, are furnished with teeth, and serve to the little labourers as tools, with which they perform a variety of operations, as manipulating the wax, constructing the combs, and polishing them, seizing their enemies, destroying the drones, &c. The *lower jaws* or maxillæ, divided vertically as the others, form, together with the labium or under lip, the complicated apparatus of the Proboscis. Its parts are represented in the following figure.



This organ, beautiful in its construction, and admirably adapted to its end, serving to the insect the purpose of extracting the juices secreted in the nectaries of flowers, consists, principally, of a long slender piece, named, by entomologists, the *Ligula*, and erroneously, though, considering its position and use, not unnaturally, regarded as the tongue, (Wood-Cut, page 34, fig. *a*.) It is, strictly speaking, formed by a prolongation of the lower lip. It is not tubular, as has been supposed, but solid throughout, consisting of a close succession of cartilaginous rings, above forty in number, each of which is fringed with very minute hairs, and having also a small tuft of hair at its extremity. It is of a flattish form, and about the thickness of a human hair; and from its cartilaginous structure, capable of being easily moved in all directions, rolling from side to side, and lapping or licking up whatever, by the aid of the hairy fringes, adheres to it. It is probably, by muscular motion, that the fluid which it laps, is propelled into the pharynx or canal, situated at its root, and through which it is conveyed to the honey-bag.

From the base of this lapping instrument, arise the labial Palpi or Feelers, composed of four articulations, (*b, b.*) of unequal length, the basal one being by much the longest, and whose peculiar office is to ascertain the nature of the food; and both these and the ligula are protected from injury by the maxillæ or lower jaws, (*c, c.*) which envelop them, when in a quiescent state, as between two demi-sheaths, and thus present the appearance of a single tube. About the middle of the maxillæ, are situated the maxillary

palpi, of very diminutive size, but having the same office to perform as those situated at the base of the ligula. The whole of the apparatus is capable of being doubled up by means of an articulation or joint in the middle. The half next the lip bends itself inwards, and lays itself along the other half which stretches towards the root, and both are folded together, within a very small compass, under the head and neck. The whole machinery rests on a pedicle, not seen in the figure, which admits of its being drawn back or propelled forwards to a considerable extent. The celebrated naturalist, Ray, whose knowledge of the minutiae of insect anatomy was but slender, "was," Kirby remarks, "at a loss to conceive what could be the use of the complex machinery of the proboscis. We who know the admirable art and contrivance manifested in the construction of this organ, need not wonder, but we shall be inexcusable if we do not adore." *

The Trunk of the Bee, or Thorax, (Wood-Cut, p. 31, fig. 2, *a*.) approaches in figure to a sphere, and is united to the head by a pedicle or thread-like ligament. It contains the muscles of the wings and legs. The former consist of two pair of unequal size, and are attached to each other by slender hooks, easily discernible through a microscope, and thereby their motion, and the flight of the insect, are rendered more steady. Behind the wings, on each side of the Trunk, are situated several small orifices, called *stigmata* or spiracles, through which respiration is effected. These orifices are connected with a system

* Monographia Apum Angliae, II. 342.

of air-vessels, pervading every part of the body, and serving the purpose of lungs. The rushing of the air through them against the wings, while in motion, is supposed to be the cause of the humming sound made by the Bees.

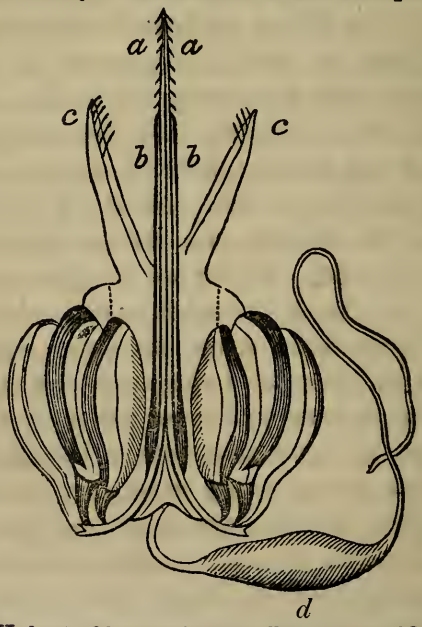
To the lower part of the trunk are attached three pair of Legs. The anterior pair, which are most efficient instruments, serving to the insect the same purpose as the arms and hands to man, are the shortest, and the posterior pair the longest. In each of these limbs there are several articulations or joints, of which three are larger than the others, serving to connect the thigh, the leg or pallet, and the foot or tarsus; the others are situated chiefly in the tarsus. (Plate II. Fig. 2., *a.* the haunch, *b.* the thigh, *c.* the tibia or pallet, containing on the opposite side, as represented at Fig. 4 *a.*, the basket or cavity; *d*, *e.* the foot.) In each of the hinder limbs, one of which is represented in Plate II. Fig. 2, there is an admirable provision made for enabling the Bee to carry to its hive an important part of its stores, and which neither the queen nor the male possess, being exempted from that labour, viz. a small triangular cavity of a spoon-like shape, the exterior of which is smooth and glossy, while its inner surface is lined with strong close-set hairs. This cavity forms a kind of *basket,* destined to receive the pollen of flowers, one of the ingredients composing the food of the young. It receives also the *propolis,* a viscous substance, by which the combs are attached to the roof and walls of the hive, and by which any openings are stopped that might admit vermin or the cold.

The hairs with which the basket is lined, are designed to retain firmly the materials with which the thigh is loaded. The three pair of legs are all furnished, particularly at the joints, with thick-set hairs, forming brushes, some of them round, some flattened, and which serve the purpose of sweeping off the farina. There is yet another remarkable peculiarity in this third pair of limbs. The junction of the pallet and tarsus is effected in such a manner as to form, by the curved shape of the corresponding parts, "a pair of real pincers. A row of shelly teeth, (Pl. II. Fig. 3 *a*,) like those of a comb, proceed from the lower edge of the pallet, corresponding to bundles of very strong hairs, with which the neighbouring portion of the brush is provided. When the two edges of the pincers meet—that is, the under edge of the pallet, and the upper edge of the brush, the hairs of each are incorporated together."* The extremities of the six feet or tarsi, terminate each in two hooks, with their points opposed to each other, by means of which the Bees fix themselves to the roof of the hive, and to one another, when suspended, as they often are, in the form of curtains, inverted cones, festoons, ladders, &c. From the middle of these hooks proceeds a little thin appendix, which, when not in use, lies folded double through its whole breadth; when in action it enables the insect to sustain its body in opposition to the force of gravity, and thereby adhere to, and walk freely and securely upon glass and other slippery substances, with its feet upwards.

* Huber's Observations on Bees, p. 351.

The Abdomen, (Plate III. figs. 3, 4, 5, & 6,) attached to the posterior part of the thorax by a slender ligament like that which unites the thorax and the head, consists of six scaly rings of unequal breadth. It contains two stomachs, the small intestines, the venom-bag, and the sting. An opening, placed at the root of the proboscis, is the mouth of the *oesophagus* or gullet, which traverses the trunk, and leads to the anterior stomach. This last named vessel is but a dilatation of the gullet, and in fact forms the honey-bag. When full, it exhibits the form of a small transparent globe, somewhat less in size than a pea. It is susceptible of contraction, and so organised as to enable the Bee to disgorge its contents. The second stomach, which is separated from the first, of which it appears to be merely a continuation, only by a very short tube, is cylindrical, and very muscular; it is the receptacle for the food, which is there digested, and conveyed by the small intestines to all parts of the body for its nutriment. It receives also the honey from which wax is elaborated. Scales of this last mentioned substance are found ranged in pairs, and contained in minute receptacles under the lower segments of the abdomen. No direct channel of communication between the stomach and these receptacles or wax-pockets has yet been discovered; but Huber conjectures that the secreting vessels are contained in the membrane which lines these receptacles, and which is covered with a reticulation of hexagonal meshes analogous to the inner coat of the second stomach of ruminating quadrupeds. Plate III. Fig. 1,

copied from Huber, gives a representation of one of the segments or rings, in which *a b* is a small horny prominence, forming the division between two areas which are bounded by a solid edge *c n d g m e*. "The scales of wax, (Fig. 2,) are deposited in these two areas, and assume the same shape, viz. an irregular pentagon. Only eight scales are furnished by each individual Bee, for the first and last ring, constituted differently from the others, afford none. The scales do not rest immediately on the body of the insect; a slight liquid medium is interposed, which serves to lubricate the junctures of the rings, and facilitate the extraction of the scales, which might otherwise adhere too firmly to the sides of the receptacles." *



* Huber's Observations on Bees, page 324.

THE STING, with its appendages, (annexed Wood-Cut,) lies close to the last stomach, and, like the proboscis, may seem to the naked eye a simple instrument, while it is, in fact, no less complex in its structure than the former apparatus. Instead of being a simple sharp-pointed weapon, like a fine needle, it is composed of two branches or darts, *a a*, applied to each other longitudinally, and lodged in one sheath, *b b*. One of these darts is somewhat longer than the other; they penetrate alternately, taking hold of the flesh, till the whole sting is completely buried. The sheath is formed by two horny scales, (themselves inclosed within two fleshy sheaths, *c c*,) along the groove of which, when the sting is extruded, flows the poison from a bag or reservoir *d*, in the body of the insect near the root of the sting. The darts composing this weapon, are each furnished with five teeth or barbs, set obliquely on their outer side, which give the instrument the appearance of an arrow, and by which it is retained in the wound it has made, till the poison has been injected; and though it is said the insect has the power of raising or depressing them at pleasure, it often happens that when suddenly driven away, it is unable to extricate itself without leaving behind it the whole apparatus, and even part of its intestines; death is the inevitable consequence. Though detached from the animal, this formidable weapon still retains, by means of the strong muscles by which it is impelled, the power of forcing itself still deeper. On the subject

of the sting, Paley* ingeniously remarks: "The action of the sting affords an example of the union of *chemistry* and *mechanism;* of chemistry, in respect to the venom which in so small a quantity can produce such powerful effects: of mechanism, as the sting is not a simple, but a compound instrument. The machinery would have been comparatively useless—*telum imbelle*—had it not been for the chemical process, by which, in the insect's body, *honey* is converted into *poison;* and on the other hand, the poison would have been ineffectual without an instrument to wound, and a syringe to inject the fluid."

Having noticed these particulars in the anatomical structure of the working-bee, as the general representative of the species, we shall next point out in what it differs from the conformation of the queen, and the male or drone. The queen is frequently styled by the Continental Naturalists the *Mother-Bee,* and with great propriety; as it seems now ascertained that her distinguishing qualities have a closer reference to the properties of a parent, than to the province of a sovereign. Her body differs from that of the worker, (Pl. 1, fig. 2,) in being considerably larger, and of a deeper black in the upper parts, while the under surface and the limbs are of a rich tawny colour. Her proboscis is more slender; her legs are longer than those of the worker, but without the hairy brushes at the joints; and as she is exempted

* Natural Theology, page 234.

from the drudgery of collecting farina or propolis, the posterior pair are without the spoon-like cavity found in those of her labouring offspring. When about to become a mother, her body is considerably swollen and elongated, and her wings in consequence appear disproportionally short. The abdomen of the queen contains the ovarium, (Plate IV.,) consisting of two branches, each of which contains a large assemblage of vessels filled with eggs, and terminating in what is called the oviduct. This duct, when approaching the anus, dilates itself into a larger receptacle into which the eggs are discharged, and which is considered by Naturalists as the sperm-reservoir, or depository of fecundating matter; from thence they are extruded by the insect, and deposited in the cell prepared for their reception. The sting possessed by the Queen is bent, while that of the worker is straight; it is seldom, however, brought into action,—perhaps only in a conflict with a rival queen.

The male, (Pl. 1, fig. 1,) is considerably more bulky than the working Bee. The eyes are more prominent; the antennæ have thirteen articulations instead of twelve; the proboscis is shorter, the hind-legs have not the basket for containing farina, and he is unprovided with a sting. The cavity of the abdomen is wholly occupied with the digestive and reproductive organs. The very loud humming noise he makes in flying, has fixed upon him the appellation of Drone.

THE SENSES OF BEES.

Much uncertainty has prevailed on the subject of the senses possessed by this insect, not so much, perhaps, in regard to their *existence* as to the *locality* of the organs. Most naturalists admit their possession of five senses, analogous to those of man, though the celebrated Huber seems to have some doubt as to the existence of the faculty of hearing in Bees, at least without some important modifications. Greater diversity of opinion, however, prevails as to the *situation* of those organs by which the impressions of sight, touch, taste, sound, and smell are produced on their sensations; and many curious experiments by different naturalists have been made with a view to ascertain the truth, but which have not always led to the same results. In researches so minute, it is, perhaps, vain to look for perfect accuracy in our conclusions, and we must be satisfied with any thing like a reasonable approximation to the truth.

Sight.—In our remarks on the anatomical structure of the head of the Bee, we observed, that, besides the large reticulated eyes placed, as in other animals, on the sides of the head, this insect possessed three *stem-*

mata or coronetted eyes, arranged triangularly on its centre, between the antennæ. That these little specks are, in reality, organs of vision, has been made apparent from accurate experiments, in which, when the reticulated eyes were blindfolded, the insect was evidently not deprived of sight, though the direction of its flight, being vertical, seemed to prove that the stemmata were adapted only or chiefly to upward vision. This additional organ must, doubtless, add considerably to its power of sight, though, probably, its aid may be confined chiefly to the obscure recesses of the hive. As the internal operations of the insect in the honey season are carried on during the night as well as the day, the coronet-eyes may, as Reaumur conjectures, serve to it the purpose of a microscope. As to the general power of vision in the Bee, its organs appear better adapted to distant objects than to such as are close at hand. When returning loaded from the fields, it flies with unerring certainty, and distinguishes at once its own domicile in the midst of a crowded apiary. Yet every person who has at all made this insect the subject of observation, must have seen it often at a loss, in returning to its hive to find the entrance, especially if its habitation has been shifted ever so little from its former station; nay, if, without moving the hive, the entrance has been turned round a single inch from its former position, the Bee flies with unerring precision to that point on the alighting board where the door formerly stood, and frequently, after many fruitless attempts to find the entrance, it is forced to rise again into the air, with a view, we

may suppose, of removing to such a distance from the desired object as is suited to the properties or focus of its visual organ. We are led to conclude, therefore, from these well-known facts, that the eye of the Bee has a lengthened focus, and that it must depend on the aid of other organs in those operations wherein its attention is directed to objects close at hand.

Feeling or Touch.—The organs of this sense are supposed, with reason, to reside in the antennæ and palpi or feelers, particularly in the former, Huber concludes that the antennæ supply the want of sight in the interior of the hive, and that it is solely by their means they are enabled to construct their combs in darkness, pour their honey into the magazines, feed the young, judge of their age and necessities, and recognise their queen. Though it does by no means appear clear that the bees are devoid of sight when employed in their in-door operations,—though, on the contrary, there is reason to believe, as already stated, that the stemmata or ocelli serve as orbs of vision,—this naturalist is probably not wrong in ascribing to the antennæ an important share in these operations. That the bees use them as means of communication and recognition, seems readily admitted by apiarians. When a hive has lost its queen, the event, as may well be supposed, causes a high degree of agitation in the colony; the disturbed workers, who have first, by some unknown means, acquired the knowledge of this public calamity, soon quit their immediate circle, and, "meeting their companions," says Huber, "the antennæ are reciprocally crossed, and they slightly strike

them." The communication made by these means is quickly disseminated, and in a few minutes the whole colony is in a state of agitation and distress. Of the antennæ being employed as instruments of recognition, the same naturalist gives a striking instance, which our limits prohibit us from giving in his own words; suffice it to say here, that by means of a wire grating, wide enough only to admit the circulation of air, inserted in the middle of the hive, he separated the queen from the half of her subjects, and ascertained that neither sight, hearing, nor smell made the near neighbourhood of their sovereign known to them, for they proceeded to rear a new queen from the larva of a worker, as if the other were irrecoverably lost. But when he substituted a grating wide enough to allow the transmission of the antennæ, all went on as usual, for the bees soon ascertained by these organs the existence of their queen.

Another important use which the bees make of this organ of touch deserves notice. "Let us follow their operations by moonshine, when they keep watch at the opening of the hive to prevent the intrusion of moths then on the wing. It is curious to observe how artfully the moth knows to profit to the disadvantage of the bees which require much light for seeing objects, and the precautions taken by the latter in reconnoitering and expelling so dangerous an enemy. Like vigilant sentinels, they patrole around their habitations with their antennæ stretched out straight before them, or turning to right and left; woe to the moth if it cannot escape their contact; it tries to glide along between

the guards, carefully avoiding their flexible organs, as if aware that its safety depended on its caution."*

Taste. In Bees, Taste appears, on a slight view, to differ most materially from that sense in man; and because with all their eager fondness for the rich nectar of flowers, they are frequently detected lapping the impure fluid from corrupted marshes, it has been hastily concluded, that their sense of Taste is very defective. Huber thought it the least perfect of the Bee-senses, and instances their gathering honey even from poisonous flowers, and regaling themselves with fœtid liquids. Now, with deference to this distinguished observer, it may be permitted, perhaps, to defend our favourites from so injurious an imputation. We have *prima facie* evidence of the delicacy of their taste in their eager activity in collecting their delicious stores of honey secreted by the most fragrant flowers; and such is their ardour in these operations, that they defy the elements when the honey-season is at its height, and, laying aside their usual fears of bad weather, boldly encounter wind and rain to get at their favourite fluid. Huber acknowledges, that when "the lime-tree and black grain blossom, they brave the rain, depart before sunrise, and return later than ordinary. But their activity relaxes after the flowers have faded; and when the enamel adorning the meadows has fallen under the scythe, the Bees remain in their dwelling, however brilliant the sunshine." Wherefore have they not,

* Huber, 284.

in this decline of the flowering season, recourse to the foul marsh and slimy pool, which they are charged with frequenting? Simply because the purposes for which they did frequent these unwholesome liquids have already been answered. The truth is, the Bees have recourse in spring, but generally speaking, in spring only, to dunghills and stagnant marshes, for the sake of the salts with which they are impregnated, and which their instinct teaches them are advantageous to their health after their long winter confinement. If we place before the Bees a portion of honey, and a portion of liquid drawn from a corrupt source, their choice will completely vindicate the purity of their taste, and their power of discrimination in the selection of their food.

It is not meant to be denied, however, that the sense of taste in Bees is ever at fault. This would be going in the face of some well authenticated instances of honey being injured, and even rendered dangerous, in consequence of the Bees feeding on noxious plants. Towards the close of the year, when flowers become scarce, and in those parts of the country where alders abound, and where onions and leeks are cultivated on a large scale, and allowed to run to seed, the Bees, from taste, or from necessity, or from anxiety to complete their winter stores, are seen to feed on these plants, which communicate to the honey a very disagreeable flavour. But this is not all. The fact stated by Xenophon in the retreat of the Ten Thousand, and confirmed by Diodorus Siculus, proves that there are plants in

Asia Minor which give to the honey not only disagreeable, but poisonous qualities. He tells us that the soldiers, having eaten a quantity of honey in the environs of Trebizonde, were seized with vertigo, vomitings, &c. This effect was attributed to the rose-laurel, (Rhododendron Ponticum,) and yellow azalea, (Azalea Pontica.) Father Lamberti, also, assures us that a shrub of Mingrelia produces a kind of honey which causes very deleterious effects. It is quite possible that the poisonous juices extracted from these plants might be innoxious to the Bees themselves, and thus the correctness of their taste might be so far vindicated. Sir J. E. Smith asserts, that "the nectar of plants is not poisonous to Bees;" and an instance is given in the American Philosophical Transactions, of a party of young men, who, induced by the prospect of gain, having removed their hives from Pennsylvania to the Jerseys, where there are vast savannahs, finely painted with the flowers of the Kalmia angustifolia, could not use or dispose of their honey on account of its intoxicating quality; yet "the Bees increased prodigiously;" an increase only to be explained, says Dr. Bevan in his Honey-Bee, by their being well and *harmlessly* fed. Nor is this defence of the taste of Bees successfully controverted by the following occurrence stated in Nicholson's Journal.* "A large swarm of Bees having settled," observe that they had merely alighted upon it, to rest perhaps after a long flight, "on a branch of the poison-ash, (Rhus Vernix, L.) in the county of West

* Page 287.

Chester in the province of New York, was put into a hive and removed to the place where it was to remain. Next morning the Bees were found dead, swelled to double their natural size, and black, except a few which appeared torpid and feeble, and soon died on exposure to the air." This was attributed to their being poisoned, not by their having fed upon, but by the *effluvia* of the Rhus Vernix.

Hearing.—Considerable difference of opinion has prevailed amongst Naturalists, both as to the existence of this sense in Bees, and the situation of the organ. Aristotle was doubtful whether Bees possess this sense: "Incertum est, an audiant." Linnæus and Bonnet denied them the faculty, and Huber seems undecided on the point; while a host of others, among whom are ranked Kirby and Spence, maintain its existence, and place the organ in the antennæ. We know that the Bees *dislike noise,* for an apiary situated near mills, smithies, or other noisy work-shops, is seldom prosperous. The different modulations of sound produced by the wings in flying, seem intended as means of communication addressed to an organ of hearing, as signals of attack, of recal, of departure, &c. In consequence of a belief in the reality of this sense in Bees, the practice is common of beating sonorous bodies at the moment of swarming, in order to prevent them from communicating with one another, and thus to present an obstacle to their flying away. We know also that many other insects possess this faculty; and, as we observe in the proceedings of Bees, the same

effects which in other insects unquestionably proceed from the sense of hearing, we regard these effects as presumptive evidence of the former possessing the same faculty. Huber sets out with intimating a doubt of its existence,—possibly in deference to his friend Bonnet, to whom his letters are addressed, and who was an unbeliever in its reality,—yet in the end confesses that he is strongly tempted to believe in it, or at least to admit a sense in Bees *analogous* to hearing, observing that certain sounds, as produced by Bees, apparently serve as a signal to their companions, and are followed by regular consequences, and that, therefore, they may be additional means of communication to those afforded by the antennæ. He mentions particularly a sound emitted by the queen, which produces paralyzing effects on the Bees in certain circumstances. Describing the attempts of a reigning queen to destroy her rivals while yet in their cells, he tells us, that "the Bees on guard pulled, bit her, and chased her away." In these circumstances she emitted the sound alluded to; "standing, while doing so, with her thorax against a comb, and her wings crossed on her back, in motion, but without being unfolded or farther opened. Whatever might be the cause of her assuming this attitude, the Bees were affected by it; all hung down their heads, and remained motionless."* On another occasion, after a queen had put her rival to death, "she approached a royal cell, and took this moment to utter *the sound*, and assume that posture which

* Huber, 157.

strikes the Bees motionless."* This discovery of Huber has been brought forward on his authority by Naturalists, as a conclusive evidence of the existence of the auditory faculty in Bees. And so it would be, if Huber was not mistaken in his supposed discovery. A voice of sovereignty producing such powerful and instantaneous effects on her subjects, is so remarkable a property of her Bee-majesty, that it would be desirable to have its existence proved beyond doubt by succeeding experiments. With much confidence in the accuracy of this distinguished Naturalist's observations, we entertain some hesitation on the subject of this magical sound. We have seen the queen in all the circumstances, and in all the positions observable within a hive; (with one exception, viz. combating a rival queen,) we have observed her very frequently in the particular situation described by Huber when he first heard the commanding voice, endeavouring to tear open the cell of a rival, and angrily repulsed by the workers; then standing at a little distance on the surface of the comb, with her wings crossed over her back, and in motion, though not fully unfolded, and emitting the clear distinct sound which is heard in a hive for a day or two before the departure of a second swarm; and certainly we never witnessed any such effect produced on the Bees as Huber speaks of, and which, had it taken place, could not possibly have escaped our observation. On the contrary, the Bees seemed not in the slightest degree affected by her

* Huber, 162.

wrath, for she was evidently in a state of great irritation, but continued to surround the cell of the captive queen with a dogged-looking obstinacy, apparently expecting and prepared for another attempt on it by the enraged sovereign. Huber may be in the right, and his general accuracy affords a presumption in his favour; nevertheless, it would be very satisfactory to have his accuracy in this particular point confirmed by some other observer. Taking it for granted that the sense of hearing does exist in Bees, where are we to look for the situation of the organ? Naturalists are not agreed on this point, but the majority seem to vest it in the antennæ. Kirby and Spence notice the analogy borne by antennæ to the ears of vertebrate animals, such as their corresponding in number, and standing out of the head; and observe that no other organ has been found which can be supposed to represent the ear. In that case this appendage of the head of the Bee must be regarded as a compound organ, exercising the functions of both *hearing* and *touch*. It has already been hinted that some observers have regarded it as the organ of *vision;* and we shall afterwards find that there are those who look upon it as the organ of *smell*. In this deficiency of precise knowledge on the subject, we may perhaps rest satisfied with the opinion of Kirby, that "the antennæ, by a peculiar structure, may collect notices from the atmosphere, receive pulses or vibrations, and communicate them to the sensorium, which communications, though not precisely to be called *hearing*, may answer the same

purpose." The same author gives an anecdote of another insect, which goes to prove that the antennæ are indeed the organs of this sense:—"A little moth was reposing on my window; I made a quiet, not loud, but distinct noise; the nearest antennæ immediately moved towards me; I repeated the noise at least a dozen times, and it was followed every time by the same motion of that organ, till at length the insect being alarmed, became agitated and violent in its motions. In this instance it could not be *touch*, since the antennæ were not applied to a surface, but directed towards the quarters from which the sound came, as if to listen."

Smelling.—Of all their senses, that of smell in Bees is the most acute. Attracted by the fragrance of the flowers, we see them winging their eager way to a very considerable distance, in a straight undeviating course, and in the very teeth of a strong wind,* in search of those plants which promise an abundant

* It has been said that Bees ballast themselves with sand or gravel when in danger of being blown away by the wind. The notion was first entertained by Aristotle, and repeated by Virgil, to whose poetic imagination such a trait in the habits of his favourite insects would be highly grateful:—

Saepe lapillos
Ut cymbae instabiles, fluctu jactante saburram
Tollunt: his sese per inania nubila librant.

Pliny has also lent his aid to the currency of this notion; and it is found in Dissertations on the Natural History of Bees, as a surprising instance of bee-instinct, notwithstanding the corrections of Swammerdam and Reaumur, both of whom have shewn that the *Mason-Bee* has been mistaken for the *Honey-Bee*, the former of whom is often seen hastening through the air, loaded with sand and gravel, the materials of its nest.

honey-harvest. Very striking proofs of the acuteness of this sense may be observed within the limits of the apiary. Early in spring, when the bee-master begins feeding his colony, he has reason to marvel at the instantaneous notice which this organ gives them of his approach. Arriving amongst his hives, though from the chillness of a spring morning, not a bee is seen stirring out of doors, he has not time to fill the feeding-troughs from the vessel in his hand, before he is surrounded by hundreds; and in the space of five minutes or less, the float-board of every trough is covered with a dense mass of eager feeders. In feeding a newly-lodged swarm during unfavourable weather in summer, it is curious to observe through the glass, in pushing in the sliding-trough which runs flush with the floor, the motionless hemispherical mass at the ceiling of the hive, becoming instantaneously elongated, and changed into the form of an inverted living pyramid, having its apex resting on the float-board, while a score or two of stragglers, who have in the confusion been separated or have fallen from the mass above, hasten along the floor, snuffing the grateful fragrance, ranging themselves in a line on the edge of the trough, and eagerly plunging their probosces into the liquid. It is to their exquisite sense of smell also, in all likelihood, that we must attribute their capability of distinguishing friend from foe among their own species. If a stranger-bee by mistake enter a hive, and this sometimes happens in consequence of some slight alteration in the arrangement of the apiary, his close resemblance to his

fellow-insects will not secure him from an immediate attack from all quarters; he is detected by a more subtle sense than vision, and instant flight alone can save him. Huber, to whose researches we are so much indebted in regard to the senses of Bees, has made some very conclusive experiments on that of smell, all of which we have repeated with precisely the same results. Like his, our first experiment was to ascertain the acuteness of the sense. He concealed a vessel with honey behind the shutters of an open window, near the apiary. In our experiment, a small box containing a portion of honey mingled with ale, and covered with a piece of wire-gauze, was placed at a distance of 100 yards from the apiary, close to the bottom of a hedge, where it was by no means conspicuous. In a quarter of an hour, a bee alighted on the box, and in a few minutes more, while this bee was eagerly exploring and striving to gain an entrance, several more joined it. The cover was then raised, and admission given; and after the first visitors had gone off with a bellyful, the feeders increased in the space of an hour to hundreds.

To diversify the trial, Huber procured four small boxes, to the apertures of which, large enough to admit a bee, he fitted shutters or valves, made of card-paper, which it was necessary should be forced open in order to gain admission. Honey being put into them, they were placed at the distance of 200 paces from the apiary. In half an hour, bees were seen arriving; carefully traversing the boxes, they soon discovered the openings, pressed against the valves, and reached the

honey. This is a striking instance of the delicacy of smell in these insects, as not only was the honey quite concealed from view, but its odorous effluvia from its being covered and disguised in the experiment, could not be much diffused. We repeated successfully the same experiment. In fact, after the first trial, we had no doubt of the issue of the second; for if once the sense of smell in the Bees ascertained the existence and situation of the honey, we had seen enough of their ingenuity in other cases, not to doubt their success in obtaining entrance. In endeavouring to ascertain the precise situation of the organ, there is considerable difficulty, and our curiosity cannot easily be gratified without some sacrifice of bee-life. Huber's experiment to ascertain this point, is full of interest, and we recommend a perusal of the account of it as detailed in his work. He dipped a pencil in oil of turpentine, a substance very disagreeable to insects, and presented it to the thorax, the stigmata, the abdomen, the antennæ, the eyes, and the proboscis, without the bee betraying the slightest symptom of uneasy feeling. It was otherwise when he held it to the mouth; it started, left the honey by which it had been enticed, and was on the point of taking flight when the pencil was withdrawn. He next filled the mouth with flour-paste, when the insect seemed to have lost the sense of smell altogether. Honey did not attract it, nor did offensive odours, even the formidable turpentine, annoy it. The organ of smell, therefore, appears to reside in the mouth, or in the parts depending on it. To those who

may wish to repeat this experiment, we would recommend that they previously deprive the bee under operation of a portion of its sting, which may be easily done by forcing the insect to extrude it, and then snipping it off about the middle with a pair of scissors; the excision will not vitally injure the insect, and will give confidence to the experimenter.

We cannot conclude this disquisition on the sense of smell in Bees, without gratifying our readers by extracting from Dr. Bevan's work, a remarkable instance of its acuteness and delicacy; and which had been communicated to him, by the son of the gentleman who is the subject of it. It is generally believed that bees have an antipathy to particular individuals, arising, probably from some peculiar odour about them, which, though not discernible by, or unpleasant to man, may be so to this sensitive insect. "M. de Hofer, Conseilleur d' Etat du Grand Duc de Baden, had for years been a proprietor and admirer of Bees, and rivalled Wildman, in the power he possessed of approaching them with impunity. He would at any time search for the queen, and taking hold of her gently, place her on his hand. But he was unfortunately attacked with a violent fever, and long confined by it. On his recovery, he attempted to resume his favourite amusement among the Bees, returning to them with all that confidence and pleasure which he had felt on former occasions; when, to his great surprise and disappointment, he discovered that he was no longer in possession of their favour; and that instead of being received by them as an old

friend, he was treated as a trespasser; nor was he ever able after this period to perform any operation with them, or to approach within their precincts, without exciting their anger. Here then it is pretty evident that some change had taken place in the Counsellor's secretions in consequence of the fever, which though not noticeable by his friends, was offensive to the olfactory nerves of the Bees." *

Functions of the inmates of a hive.—A hive consists of the Queen, or mother-bee, the Workers varying in numbers, from 10,000, to 20,000 or 30,000, and the Males or Drones, from 700 to double that number.

Functions of the Queen.—(see Pl. I. Fig. 1.)—The QUEEN is the parent of the hive; and her sole province and occupation consist in laying the eggs, from which originate those prodigious multitudes that people a hive, and emigrate from it in the course of one summer. In the height of the season, her fertility is truly astonishing, as she lays not fewer than 200 eggs per day, and even more when the season is particularly warm and genial, and flowers are abundant; and this laying continues, though at a gradually diminishing rate, till the approach of cold weather in October. So early as February, she resumes her labours in the same department, and supplies the great blank made in the population by the numerous casualties that take place between the end of summer and commencement of spring. Her *great laying* of the eggs of workers begins generally

* Bevan's Honey-Bee, p. 304.

about the fifth day of her age; and she continues to deposit eggs of the same kind for the succeeding eleven months; after which she commences laying those of males. It is during the depositing of these last, that the Bees are led by their instinct to lay the foundation of royal cells, in which, if the population be abundant, the Queen deposits eggs at intervals of one or two days between each. In the operation of laying, which we have a thousand times witnessed, the Queen puts her head into a cell, and remains in that position about a second or two, as if to ascertain whether it is in a fit state to receive the deposit. She then withdraws her head, curves her body downwards, inserts her abdomen into the cell, and turns half round on herself; having kept this position for a few seconds, she withdraws her body, having in the mean time laid an egg. The egg itself, which is attached to the bottom of the cell by a glutinous matter with which it is imbued, is of a slender oval shape, slightly curved, rather more pointed in the lower end than in the other. She passes on from cell to cell, furnishing each with the germ of a future inhabitant; and during these proceedings, she receives the most marked and affectionate attention from the workers. She is seen continually surrounded by a circle of them, who caress her fondly with their antennæ, and occasionally supply her with food from their probosces. This appearance has given rise to the notion commonly entertained, and asserted even by some Naturalists, that the Queen is followed in her progress through the hive by a num-

ber of her subjects formed in a circle round her, and these of course have been regarded as the Queen's *body guards.* The truth is, however that her Bee-majesty has no attendants, strictly speaking; none who follow in her train; but wherever she moves, the workers whom she encounters in her progress instantly and hurriedly clear the way before her, and all turning their heads towards their approaching sovereign, lavish their caresses upon her with much apparent affection, and touch her softly with their antennæ; and these circumstances, which may be observed every hour in the day, in a properly constructed glass hive, have given rise to the idea of guards. The moment she has left the circle, the bees who had surrounded her instantly resume their labours, and she passes on, receiving from every group in her way the homage due to a Mother and a Queen. On one occasion we gave her subjects an opportunity of testifying their *courage* in her defence as well as their affection and zeal. Observing her laying eggs in the comb next to the glass of the hive, we gently but quickly opened the pane, and endeavoured to seize her. But no sooner did the removal of the glass afford room,—(while shut it was almost in contact with her back;)—and before we could accomplish our purpose, they threw their bodies upon her to the number of at least a hundred, and formed a cone over her of such magnitude that she could not be less than two inches distant from any part of the surface. We dispersed the mass with our finger, and got hold of her precious person, and

kept looking at her for some minutes before we restored the captive to her alarmed defenders. It is remarkable that this violence was not resented by them; though they coursed over our hands in scores, while we kept hold of their mistress, not one individual used its sting. The all engrossing object was the Queen. They may be handled, and roughly too, with like impunity when they are swarming. Intent then only on securing a habitation for themselves and their sovereign, they seem incapable of entertaining at the same moment two different *ideas,* if we may use such an expression, and their natural irritability is not awakened to exertion.

There is a fact connected with the instinct of the Queen in laying her eggs, which deserves particular notice, and which we have not seen stated by any other writer on the subject of Bees.* When she has laid a cluster of eggs to the number of thirty or forty, more or less according to circumstances, on one side of the comb; instead of laying in all the empty cells in the same quarter, she removes to the other side, and lays in the cells which are directly opposite to those which she has just supplied with eggs, and, generally speaking, in none else. This mode of proceeding is of a piece with that wise arrangement which runs through all the operations of the Bees, and is another effect of that remarkable instinct by which they are guided. For as they cluster closely in those parts of the comb which are filled with brood, in order to concentrate the heat neces-

* The writer stated this fact several years ago in the Edinburgh Philosophical Journal.

sary for their being hatched, the heat will of course penetrate to the other side, and some portion of it would be wasted if the cells on that side were either empty, or filled only with honey. But when both sides are filled with brood, and covered with hive-bees, the heat is confined to the spot where it is necessary, and is turned to full account in bringing the young to maturity. See Pl. IX. Fig. 1. in which *a*, *b*, *c*, represent that part of the comb in an experimental hive where the observation was made, which was filled with brood, the rest of the square being, with the exception of the uncoloured part, sealed honey. On the opposite side, the brood comb was exactly of the same figure, insomuch that on the narrowest inspection I could hardly discern one cell which contained brood while its opposite contained honey; *e*, Royal Cell, containing a larva nearly ready to be sealed up; *f*, form of the Royal Cell at the time of the egg being deposited in it; *g*, ditto, when sealed, and just before hatching takes place; *i*, ditto, after the young Queen has been hatched; *h*, ditto, with a ragged opening in the broadside through which the dead body of a young Queen, destroyed by the Queen regnant, has been dragged out by the bees.

The mutual aversion of Queens is a striking feature in the natural history of this insect; and though not perhaps strictly in place, one extraordinary effect of it may be mentioned here. Their mutual enmity may be truly said to be an in-born disposition with them, for no sooner has the first of the race in a hive about to throw off a second swarm, escaped from her own cradle, than she hurries away in search

of those of her rivals, and, as will be afterwards described, exerts herself with the most impetuous eagerness to destroy them. When two Queens happen to emerge from their cells at the same time, a pitched battle takes place, which ends in the death of one of the combatants. We have never witnessed this interesting exhibition of bee-warfare,—this *duellum*, as described by Huber, but we have no doubt of its being a fact, after the very unequivocal proofs we have witnessed of this mutual aversion, and particularly the instance to be afterwards stated.

Functions of the Worker-Bee—(See Pl. I. Fig. 3) —The workers, to the number of 10,000, 20,000, and even 30,000, constitute the great mass of the population, and on them devolve the whole labours of the establishment. Theirs is the office of searching for and collecting the precious fluid which not only furnishes their daily food, as well as that of their young, and the surplus of which is laid up for winter stores, but also the materials from which they rear their beautiful combs. In the little basket-shaped cavity in their hind-legs, they bring home the pollen or farinaceous dust of flowers, kneaded by the help of the morning dew into tiny balls, which form an important ingredient in the nourishment of the brood; and also the propolis or adhesive gum extracted from willows, &c. with which they attach their combs to the upper part and sides of the hive, and stop every crevice that might admit the winter's cold. Exploring a glass hive in a soft spring morning, and following with his eye a Bee loaded with

farina, the observer will perceive the little active forager, on her arrival in the interior, hurrying over the surface of the comb in search of a proper cell in which to deposit her burden; and having found one, fastening herself by the two fore-feet on its superior border, then bending her body a little forward, that her hinder feet may catch hold of the opposite edge of the cell. In this position she is next seen thrusting back her second pair of feet, one on each side, and sweeping with them from top to bottom along the two hinder legs, where the farina balls are fixed, and by this means detaching them from the hairy linings of the cavities, and depositing them in the cell. To the workers, also, are committed the various offices of guarding the entrance of the hive by night and day, during the honey season; of repulsing marauders—of keeping their abode free from all offensive matters—of renewing the air within by an ingenious mode of ventilation—of replacing a lost Queen, and of destroying the drones at the decline of the honey season. Receiving from nature these weighty charges, they labour assiduously to fulfil them; and, while each member of the community acts by the impulse of its individual instinct, it works less for private than for the general good. These labours appear unceasing; yet do the weary labourers sometimes snatch an interval of repose. During the busy season, we have seen hundreds of the workers retiring into the cells, and exhibiting all the marks of profound sleep. This fact is very easily observable, especially in those cells which are con-

structed—as sometimes happens—against the glass, and where that substance forms one side of the cell. There they are, the fatigued labourers, stretched at full length, with their heads at the bottom, and every limb apparently in a relaxed state, while the little body is seen heaving gently from the process of respiration. Huber thinks he has ascertained that there are two kinds of workers in a hive, one of which he calls *Wax-workers,* and the other *Nurses.* The difference between these Bees had probably been observed by Aristotle and Pliny. The former speaks of "*optimum genus apum, quæ breves, variæ, et in rotunditatem compactiles; secundæ quæ longæ et vespis similes.*" Pliny uses similar language. It does not appear, however, that these naturalists were acquainted with the different functions—if the difference really does exist—of the two classes. The office of the first class, according to Huber, is not only to collect honey—which both kinds do—but also to elaborate the wax, and construct the combs. The particular function of the other, is to take care of the young. They may be distinguished in entering the hive, by carefully examining their shape ; the wax-workers having their bellies somewhat cylindrical, while those of the nurses retain their ovoidal figure. The anatomical structure of the two is said to be different, and the capacity of stomach not the same ; so that the one species is incapable of fulfilling all the functions of the other. Huber has also directed our attention to a class of workers, which he calls *Black*

*Bees,** and which he first observed in 1809, and on several other occasions from that time to the year 1813. In every thing they bear a perfect resemblance to their fellow-workers, except in colour, which in them is a deep black. He describes them as persecuted by the other workers, and finally expelled the hives, or destroyed. We have noticed them, though rarely; perhaps not more than one or two in a season. The other Bees did not molest them, as far as we observed, nor indeed seem in any way sensible of their presence. It is not improbable, as Kirby and Spence conjecture, that they are merely *aged Bees*, and that their deeper colour arises from the hair or down, with which the young are so thickly clothed, being worn off their bodies.

In describing the functions of the Working Bee, it would be improper to pass over unnoticed the fact, that it sometimes exercises the functions of a mother. To account for this apparent anomaly, we must remember that it has been ascertained by minutely accurate dissection, that all the workers are *females*, though of imperfect organization,—a fact confirmed by the very circumstance we are now discussing. We must also keep in mind, that the larva of a Queen is nourished with food of a different kind from that of common Bees; and this difference, in conjunction with a more roomy cell, has, in the opinion of naturalists, the effect of expanding the ovarium, and qualifying her to become a mother. It is evident,

* Huber, 235.

therefore, that, if the larva of a common Bee were fed with the royal jelly, the imperfection in her bodily organs would, as far at least as depended on the nature of the food, be removed, and she would become capable of laying eggs. Now this does occasionally take place; some of the royal food is dropped, probably by accident, into some of the cells adjoining that of the Queen, and the Bees therein reared acquire the power of laying eggs. This fact was discovered by the naturalist Riem, and has been confirmed by Huber. There is, however, a very material and hitherto unaccounted for difference between these fertile workers and perfect Queens,—the former lay the eggs of *males* only. We would certainly have expected, *a priori*, that a difference between them *should* exist; because the workers have fed on the royal jelly only for a short time, and because their birth-place is so much smaller. But we cannot easily conceive how these circumstances should be the cause of their laying only *male-eggs*. In truth, it appears to be one of those mysteries in bee-economy which, with all our researches on the subject, we cannot yet unravel. These fertile workers are never found in any hives but such as have lost their natural Queen.

The natural term of the worker's existence does not extend, we think, beyond six or eight months. It is the opinion of Dr. Bevan that all the Bees brought into existence at the Queen's great laying in spring, die before winter. But many never reach that period. Showers of rain, violent blasts of wind, sudden changes

of atmosphere, destroy them in hundreds. In the clear cold mornings and evenings of autumn, their eagerness for foraging entices them abroad early and late; when, alighting on the ground, many are chilled, and quickly perish. And should they escape the blighting atmosphere at the close of autumn, a bright sunshine in a winter day, when the ground perhaps is covered with snow, brings them abroad in multitudes, and the half of them never return. From these causes, independent of the numbers which fall a prey to enemies, a swarm which in July amounted to fifteen or twenty thousand, will, by the following February or March, have dwindled to a mere handful. It is otherwise with the Queen; going seldom abroad, she is little exposed to accidents. Her natural life is prolonged to several years, though the precise extent has not been accurately ascertained. In 1834 we had one in our possession, which we had every reason to believe was not less than four years old.

Functions of the Male or Drone,—(see Pl. I. Fig. 2.)—The sole office of the Male, or at least the primary one, is to pair with the Queen. He is the father of the hive. Indolent and luxurious, he takes no part in the internal operations of the domicile, and never leaves it with a view of sharing in the labours of the field. When he does venture abroad, it is only in the finest weather, and during the warmest part of the day, at which time the young Queens are instinctively led to go out in search of the male. He is easily distinguished from the workers by his larger size, by his heavy motion in flight, and

by his loud humming sound. We have said that the primary function of the drones is to perpetuate the race of Bees by pairing with the Queen, but some Naturalists have assigned them a secondary office, namely, that of contributing by their numbers to the heat of the hive, and thus aiding in bringing the brood to maturity. In some parts of the continent, accordingly, Feburier tells us, they have received the name of *Hatchers*. There are occasionally found Drones of a small size in hives where the impregnation of the Queen has been retarded. In such circumstances, her instinct, as we shall have occasion to shew in the following chapter, is so impaired, that she lays her eggs indiscriminately in all kinds of cells,—those of males sometimes in the cells of workers. The consequence is, that these males, when hatched, are diminutive in size, having been cramped in their growth by the smallness of their birth-place.

The life of this *vir gregis* is extremely short; the favoured lover perishes soon after his union with the female, and thus anticipates, though only by a short period, the destruction which awaits his race. So early as the beginning of August, the Bees, as if wishing to apply "the preventive check" to a superabundant idle population, begin to manifest deadly intentions towards them; and the unfortunate victims, as if to derive consolation from one another's society, or perhaps driven together by their irascible superiors, may be seen about that period clustering closely together in some corner of the combs, where they remain without motion, and without once venturing

to approach the provision-cells. Thus weakened by hunger and captivity, and disqualified for resistance by the want of a sting, they fall an easy prey to their merciless assailants; and a scene of carnage takes place which it is difficult to describe. The unhappy wretches are seen driven to the bottom of the hive, pursued with such fury, that, in spite of their strength, which is greatly superior to that of their persecutors, and which enables them to drag two or three of their assailants along the board, and even to fly off with them, they are unable to avoid the mortal thrust of their formidable stings, and expire instantaneously from the effects of the poison. But death overtakes them in various forms; for their enemies sometimes seize them by the wings, and with their strong mandibles gnaw them at the roots, and disable them from flying. They may then be seen in numbers crawling on the ground, where they perish from the cold, or are trampled under foot, and devoured by birds or frogs. Such as escape for a while, may be seen flying from destruction, lighting on the shrubs and flowers to enjoy a moment's respite from their terrors; or buzzing about our windows, or wandering about from hive to hive, into one of which they no sooner enter, than certain death awaits them. Nay, so bitter is the fury of their tormentors, that, not satisfied with destroying these unhappy beings themselves, they tear from the cells such of the doomed race as are yet in the state of larvæ, and sucking from their bodies, with instinctive economy, the fluids they contain, cast the

lifeless remains out of the hive. There are cases, however, in which this destruction of males does not take place. "In hives that have lost their queen," says Huber, "the males are spared; and, while a savage massacre rages in other hives, they here find an asylum. They are tolerated and fed, and many are seen even in the middle of January." The cause of this may perhaps be looked for in the additional heat which they would generate in winter; or perhaps they may be preserved for the purpose of pairing with a new queen.

On the Impregnation of the Queen-Bee.—In looking into a hive in spring or summer, the Queen will be seen laying eggs in the cells; in the smaller cells, those of workers, and in the larger those of males or drones. These eggs, if examined on the fourth day from their being deposited, will be found hatched, and a small worm produced, which is floating in a whitish liquid, ascertained to be food introduced for the nourishment of the infant brood; and in due time a perfect bee emerges from the cell. But how is this living animal generated? The Queen lays the egg without doubt, and the insect is evolved from it; but how is the egg fecundated or rendered fertile? Has the Queen had personal union with the male? No one can speak positively to such a fact; by what other means, then, is this effect produced?

The impregnation of the Queen-Bee is a branch of Natural History which has given rise to more discussion than almost any other fact, connected with

the nature of the insect. And indeed the difficulty, we might almost say *impossibility* of obtaining any thing like ocular evidence on the subject, will readily account for the diversity of opinion that has hitherto prevailed. And we should hope that this difficulty alone, and not any preconceived theory or unreasonable prejudice, is the cause of that determined pertinacity with which the discoveries and conclusions of Huber, on this subject, are still in some instances rejected. That justly celebrated Naturalist, instituted a set of experiments on the subject of the queen's impregnation, the result of which leads to the conclusion that it takes place in the air. For an account of these experiments, we must refer our readers to his Observations, page 18.

Retarded Impregnation.—There is a fact connected with this part of the natural history of the mother bee which involves great difficulties. The fact itself was discovered by Huber, but its cause he was unable to develope, and no succeeding naturalist has been able to free it from the obscurity in which he has left it,—we mean the effects of Retarded Impregnation. These effects are such as we could hardly credit, were not the fact confirmed by numerous experiments. If impregnation be delayed longer than twenty days from the Queen's birth, the consequence is that none but male eggs are laid, even during the whole of the Queen's life. This phenomenon has baffled every attempt to explain its cause. "There are mysteries," observes Feburier, "in the operations of nature, both in reference to the rational and irrational creation,

which will, probably, for ever remain inscrutable to man." In the natural state of things, that is, when fecundation has not been postponed, the Queen lays the eggs of workers in forty-six hours after her union with the male, and continues for the subsequent eleven months to produce these alone, and it is only after this period that a considerable laying of the eggs of drones commences. These male eggs require eleven months to attain to maturity, but, under the effects of retardation, they are matured in forty-six hours. The eggs of workers, which, in the usual state of things, would have been laid first, never come to light; their vitality has been destroyed by some vitiation which has taken place, and the cause of which has not yet been discovered. Huber, in reasoning on the subject, and contemplating the difficulty attending it, declares it to be "an abyss in which he is lost." There is another circumstance which he has not adverted to, and which seems to increase these difficulties. He asserts that before a Queen commences her *great* laying of male-eggs, she must be eleven months old. But he acknowledges that "a Queen, hatched in spring, will perhaps lay fifty or sixty eggs of drones in whole, during the course of the ensuing summer."* We know this to be true from our own experience; and also as the usual consequence of this appearance of male-eggs, that the Bees commence building royal cells,—the Queen lays in them, and swarming takes place. Now this partial laying of drone-eggs takes place only in the case of very early swarms; and if the weather be unfavour-

* Huber, page 169.

able, it does not happen even in them. But if in the natural state, the space of eleven months be necessary for the male-eggs to acquire that degree of increment they must have attained when laid, how are we to explain the fact of two or three score of these male-eggs making their appearance before the Mother-bee is six weeks old? Leaving this matter in the obscurity which we cannot dispel, we have only farther to observe, that in every case of retarded impregnation the instinct of the Queen appears to be greatly impaired. She lays her eggs indiscriminately in drone and worker cells; now and then even in royal cells; and does not evince that jealousy and irritable temperament towards her rivals, which, in the natural state, characterize the Queen.

Of the Brood.—In forty-six hours after impregnation, the Queen-bee, as already noticed, begins to lay the eggs of workers, and continues to do so without interruption throughout the season, at the rate of between 100 and 200 a day, unless cold weather intervene, when her operations are suspended, as well as the hatching retarded of the eggs already laid. The fruitfulness of the mother-bee is indeed astonishing. It has been computed that the numbers produced in a hive by one Queen during the laying season, amount to 100,000; and we are satisfied the computation is correct. In the beginning of the year it is a tolerably good stock hive which possesses a population of 2000 or 3000. Yet that same hive shall in June throw off swarms amounting to 40,000 or 50,000; in many cases the first swarm itself, and

in some even the cast or second swarm throws off a colony of 10,000 or 12,000; and still, at the end of harvest, this original stock-hive shall exhibit a population of 18,000 or 20,000. Add to all this, in some instances, though rare, a first swarm throws off *two* colonies.

Before depositing her egg, the Queen carefully examines the cell, inserting her head into it, and keeping it there for a second or two; and, as already stated (page 63), after having laid a few eggs on one side of the comb, proceeds to the other side, and with a view probably of economizing heat, supplies the corresponding cells upon that side. Her impatience or necessity to commence laying is such, that in a newly-established hive eggs will be found before there are three inches square of comb constructed, and even before the cells have attained their full depth. And in a well-peopled hive, even during winter, and while the temperature is chilled by the frosts and snows of January, and the bleak winds of the following month, the indefatigable Mother-bee is found busied in depositing eggs. We have said that the Queen begins laying eggs forty-six hours after impregnation. This does not hold true invariably. A sudden change of temperature may prolong the interval to a very considerable extent. Huber had a Queen impregnated in October, which, on account of the inclemency of the season, did not begin laying till the following spring.

The eggs, when laid, remain fixed on the superior angle of the cell, to which they are attached by a

viscous matter covering them, for three days; on the fourth, the shell, or thin enveloping membrane, bursts, and a small lively worm is deposited at the bottom. The nursing-bees instantly enter upon their vocation, and administer a copious supply of liquid food—of which farina, honey, and probably water, are the ingredients. As the larva increases in growth, the attention of the Bees in nourishing it is augmented, and indeed unremitting; for at whatever time we inspect a brood-comb, we shall observe hundreds of nurses with their bodies inserted in the cells supplying the wants of the infant progeny. Although in the vermicular state, and consequently without feet, the larvæ are capable of moving in a spiral direction. During the first three days, their motion is so slow as to be scarcely perceptible, but it afterwards becomes more evident, and they have been observed to perform two complete revolutions in less than two hours. The slightest movement of the nurse-bees approaching to minister to their wants, is sufficient to attract them to their food, which they devour most voraciously, and it is unsparingly lavished upon them. At first the liquor is nearly insipid, but acquires gradually a perceptible flavour of honey, and becomes more and more saccharine and transparent in proportion as the larva advances in growth. "It is indescribable," says Feburier, "the care which the workers lavish on these little nurslings, towards whom they seem to cherish the tenderest attachment. A comb filled with brood, and placed in an empty hive, never fails to retain them there, to the utter disregard

of the loss of their stores. The tenderest mother could not watch over her children with more affection, nor supply them with nourishment more impartially, or in greater abundance. At the same time it is done without waste, for the quantity is so proportioned to the demand, that none of it remains in the cells where the larvæ undergo their transformation to the nymph state."*

At the moment of being hatched, the insect presents the appearance of a small straight worm, composed of several ventral wings. It quickly grows so as to touch the sides of the cell, when it contracts its body, and coils itself into a semicircular figure, and continues enlarging its dimensions till the extremities meet, and form a complete ring. In this state it continues, receiving food from its nurses for five days, when it ceases to eat; its supplies are, of course, cut off, and the bees proceed to seal up the cell with a waxen cover, of a brownish colour, and slightly convex. Thus left to itself, the larva begins spinning around its body, after the manner of the silk-worm, a fine silken film or cocoon, which completely envelops it. "The silken thread employed in forming this covering," Kirby and Spence tell us, "proceeds from the middle part of the under lip, and is in fact composed of two threads, gummed together, as they issue from the two adjoining orifices of the spinner." In the formation of its cocoon, the larva occupies thirty-six hours, and in three days after, it is metamorphosed into a *nymph* or *pupa*—terms ap-

* Traité des Abeilles.

plied to the mummy-like state to which the larva is subjected, previous to its becoming a perfect insect, or *imago,* as it is termed.

During this state of concealment, various changes happen to the enclosed insect.* The first change in its situation is its ceasing to continue in that coiled position in which it originally lay at the bottom of the cell, and extending itself along its whole length with its head in the direction of the mouth of the cell. The head begins to appear from the inert-looking mass, having a small protuberance, probably the rudiment of the proboscis; the first lineaments of the feet also appear, though of diminutive size. After the head is formed, and the proboscis prolonged, all the other parts display themselves successively, and the worm is changed into the perfect insect, except that its outer covering is yet white and soft, and has not that dark scaly texture which, as a proper coat of defence, it afterwards acquires. By this transformation the larva becomes divested of its cocoon, which is attached so closely to the internal surface of the cell, that it appears to form part of its substance, and adds considerably to its thickness. These linings are sometimes found to the number of seven or eight, adhering to the sides of the cell, and have an injurious effect often, diminishing, as they do, the cell's capacity, and exciting, by their strong smell, the attacks of moths and other enemies. The number of linings found adhering to a cell, and which may be disjoined by soaking the comb in water, indicates the number

* Wildman.

of bees to which it has been the birth-place.* The Bee, thus stripped of its silken envelope, and having all its parts unfolded by degrees, and changed through a succession of colours, from a dull white to black, arrives at the state of a perfect insect on the 20th day, counting from the moment the egg is laid. She then eagerly commences the operation of cutting through, with her mandibles, the cover of her cell, and in half an hour succeeds in escaping from her prison. On quitting her cradle she appears, for a few seconds, drowsy and listless, but soon assumes the agility natural to the race—and on the same day on which she has emerged from her prison, sets out with her seniors to engage in the labours of the field.

Some of the ancient Bee-masters enlarge on the attention paid by the seniors to the young worker on emerging from her prison, describing them as licking her body, supplying her with food, and seeming to instruct her in what is necessary to render her a useful member of the community. These descriptions have been repeated by succeeding writers on the subject; and the existence of these amiable traits in the kind nurses of the young, is taken for granted as an indubitable fact in their natural history. We have reason, in consequence of repeated observations, to

* The late Dr. Barclay of Edinburgh, imagined he had discovered that the partitions of the bee-cells are *double*, and regarded this circumstance as an additional instance of the wonderful architectural powers of the Bee. It is not improbable that what he considered to be separate laminæ of wax, are but the silken linings of the cells.

disbelieve the alleged fact, and must, in accordance with the truth, withhold from our favourites the unmerited eulogiums they have received on this head. They are, in fact, in this particular, harsh and unfeeling in the extreme. In hundreds of instances have we seen and pitied the infant insect, when after having long struggled to get out of its cradle, it has at last succeeded so far as to extrude the head; and when labouring with the most eager impatience, and on the very point of extricating the shoulders also, which would at once secure its exit, a dozen or two of workers, in following their avocations, trample without ceremony over the struggling creature, which is then forced, for the safety of its head, to pop quickly down into its cell, and wait till the unfeeling crowd pass on, before it can renew its efforts to escape. Again and again are the same impatient exertions repeated by the same individual, and with similar mortifying interruptions, before it succeeds in obtaining its freedom. Not the slightest attention or sympathy is observable on the part of the workers in these circumstances; nor did we ever, in a single instance, witness the kind parental cares which seem to owe their existence to the fancy of the writers alluded to. During the larva-stage, as we have shewn, the solicitude of the workers about the welfare and nourishment of their infant charge is extreme; but from the moment they have sealed up the cell, and while the larva is undergoing its transformation, they seem to cease from every thing like *individual* attention; and though when a brood-comb is meddled with, their

utmost ire is kindled against the invader, as far as concerns the reception of the newly-hatched insect, and its introduction to the duties and avocations of the Bee-community, they appear altogether selfish and indifferent. There is another case in which this indifference appears very striking: a sudden change of weather about the end of autumn, from a mild temperature to raw frost, has such an immediate effect on the brood, that it is not uncommon to observe a young bee, which shall have so far succeeded in breaking its prison, as to extricate its head, and nearly its shoulders, yet perishing from cold in this situation, without the slightest effort on the part of the workers to save the life of a companion whose rearing has already cost them so much labour.

Immediately after the young bee has issued from the cell, the workers hasten to clean it out, clear away the ragged remains of the cover, fortify it anew with the usual strong bordering of wax, and thus prepare it for the reception of another egg, or of honey, or farina.

We have hitherto confined our observations to the progress of a *worker*, from the egg to the state of the perfect insect. The same process takes place in the case of the Males and of the Queen, though with some difference as to the time occupied in the transformation. Like those of the common bees, the eggs of Males are hatched in three days; the larva state continues six and a half days, and after having formed their cocoon, and been metamorphosed into nymphs,

they attain to the state of perfect insects on the twenty-fourth day.

We may briefly notice here the statement of Huber respecting the order in which the different kinds of eggs are arranged in the ovarium of the Queen, and the law which regulates her laying. He says, that "nature does not allow the Queen the choice of the eggs she is to lay;" that "it is ordained she shall, at a certain time of the year, produce those of males, and, at another time, the eggs of workers; an order which cannot be inverted;" that "the eggs are not indiscriminately mixed in the ovaries of the Queen, but arranged so that at a particular season she can lay only a certain kind;" that "she can lay no male eggs until those of the workers, occupying the first place in the oviducts, are discharged."* We do not mean to question this statement, as holding true *generally*, but we think it made in terms too unqualified, and that there are palpable and frequent exceptions. He has himself acknowledged elsewhere that a Queen hatched in spring will sometimes lay fifty or sixty eggs of males during the course of the ensuing summer, and we have repeatedly witnessed the fact. Now, this takes place only in certain circumstances, and under certain conditions, namely, that the family of the Queen so laying shall have been a very early swarm, that it shall abound in population, and that the season shall be genial, and the secretion of honey in the flowers plentiful. In such a favourable juncture of circumstances, it almost invariably happens

* Huber, 44 and 136.

that the Queen lays male eggs, and that, as the natural consequence, royal cells are built, in which she lays, and, in due time, she leads off a swarm. Now, does not this fact seem to imply that there is no such arbitrary arrangement of the several kinds of eggs as Huber imagines? and if it would be stretching the inference too far to say, that the Queen has the power of laying those of males or of workers as circumstances may require,—does it not imply that the statement of Huber may admit of very important and frequent exceptions?

About the twentieth day from the commencement of the laying of male eggs, the bees begin to lay the foundations of royal cells, and the Queen having resumed laying female eggs, deposits them, at intervals of one or two days, in these cells, from which are hatched, in due time, other Queens. This regular process is, however, sometimes interrupted:—if the Queen be not a fertile one, and the colony is, in consequence, weak in population; if the hive or domicile itself be large in proportion to the number of its inhabitants; or if the temperature of the season has been such as to interfere with the copious collection of honey or farina, in these circumstances no male eggs will be laid, no royal cells founded, and no swarms will issue. But, in favourable circumstances, the laying of royal eggs takes place regularly during the laying of those of males, and swarming is the consequence. The royal cell (Pl. VI.) is an inch in depth, and it has been considered difficult to comprehend how the body of the Queen can reach the bottom, so as to

attach the egg to it; but, in fact, the Queen lays when the cell is merely founded, and not deeper than that of a common bee, and it is not until the precious deposit has been made, that the workers lengthen it to the full size. The egg destined to produce a Queen, like that which is laid in a drone-cell and that of a worker, is three days old before it is hatched; as soon as this takes place, the royal larva becomes an object of devoted attention to the bees, who watch over and feed it with unremitting attention and care. "It is difficult," says M. Feburier, "to form an idea of the anxious care and attention bestowed by the bees on the royal larva. The comparison of the affection of a mother for an only child can alone furnish any thing like a conception of it. They seem to feel that their own fate is involved in that of their young sovereign; they feed her with a jelly different from that which is destined for the workers and males; it is more pungent, and moderately acid; and they supply it in such profusion that she is unable to consume it all, for, after her transformation, some remains of it are found at the bottom of the cell."

At the end of the fifth day of the larva state, the royal cell is closed, and the inhabitant begins spinning her cocoon. It is worthy of remark, that this covering is left incomplete, unlike those of the workers and males, which inclose the whole body. This fact beautifully demonstrates the admirable art with which the Author of nature has connected the various characteristics of this interesting tribe of his creatures. And the fact now under consideration is one of no

small importance in bee-economy; for, were the Queen's cocoon completely to envelope her body, her destruction by her rivals would be rendered extremely difficult; the texture of the covering is so close, that the sting would be unable to penetrate it, or, if the attempt were made, it might be entangled by its barbs in the meshes of the cocoon, and the struggling female, unable to disengage it, would become the victim of her own fury. In spinning the cocoon, the Queen spends only 24 hours; she remains in a death-like torpidity between two and three days, is then metamorphosed into a nymph, and, after remaining in that state four days and a half, she comes forth a perfect Queen on the sixteenth day. In the case of the workers and males, the transformation is no sooner completed than they are at liberty to abandon the confinement of the cradle, and hasten,—the former, at least, —to partake of the labours of the community, and to range the fields and flower-gardens in the very plenitude of bee-enjoyment. But the case is different with the young Queens; like other sovereigns, they pay the tax of their high estate in having their inclinations put under restraint for the public good. The royal insect is not permitted to leave the cell, and, as generally happens, to lead off a swarm, unless the weather be very favourable. Were she to obtain her liberty, while, at the same time, emigration was prevented by the state of the external atmosphere, or other circumstances, there would be a plurality of Queens in the hive, and mortal strife would ensue. The young Queen, therefore, is detained a captive,

and the workers, piercing a hole in the cover of the cell, insert their probosces, and supply her with food during her captivity.

On the conversion of the larva of a Worker into a Queen.—Bees, when deprived of their Queen, are endowed by nature with the power of remedying this calamity, by converting a worker larva into a royal one; and, by means of a cell of a larger size, and of a peculiar kind of nourishment, of producing a female that shall be, to all intents and purposes, a Queen or mother-bee, capable of perpetuating her kind. The discovery of this singular fact is generally attributed to Schirach, and, probably, with justice; for, although the practice of making artificial swarms, which can only be effected by causing the production of artificial Queens, is said to have prevailed amongst the modern Greeks and Italians from a very early period, it does not follow, nor does it appear from any authentic documents, that they were aware of the reason why. The manner in which Schirach made the discovery is interesting:—Having used a great quantity of smoke in some of his operations, the bees were so annoyed by it that numbers of them left the hive, and, amongst them, the Queen. Knowing the consequences of her loss, he sought for her diligently, but in vain. Next morning he observed a cluster of bees about the size of an apple on the prop of the hive whose Queen had fled; here he discovered a Queen, and, having carried her to the entrance of the hive which had lost its own, she was immediately surrounded by the bees, and treated in such a manner as plainly announced that

she was their Queen. "What was my astonishment," he proceeds, "when, wishing to introduce her among the combs, I saw that the bees remaining had already planned and almost finished three royal cells! Struck with the activity and sagacity of these creatures, to save themselves from impending distruction, I was filled with admiration, and adored the infinite goodness of God in the care taken to perpetuate his works. Having carried away two of the cells to ascertain whether the bees would continue their operations, I beheld, next morning, with the utmost surprise, that they had removed all the food from around the third worm left behind, on purpose to prevent its conversion to a Queen." The fact of this power possessed by the bees is so extraordinary, that its reality was at first called in question by several eminent naturalists, among others, by the justly celebrated Bonnet. This naturalist was at last, however, convinced of its reality by experiments instituted by himself, and, satisfied that all the working-bees are females of imperfect organisation, expressed his opinion that the evolution of the germ is effected by the action of the prolific matter as a stimulant, as a substantial nutriment suitable for that purpose; and he supposes that a certain quality of food, administered more copiously than in ordinary cases, may unfold those organs in the larvæ of bees that never would have appeared without it. He conceived, also, that a habitation, like a Queen-cell, considerably more spacious, and differently placed, is absolutely necessary to the complete developement, of organs, which

the new nutriment may cause to grow in all directions. It furnishes a surprising evidence of the slow degrees by which scientific facts make their way, if not essential to general utility, when we consider that to this day, the knowledge of this singularity in the natural history of this insect, is confined almost exclusively to apiarians, and even rejected by some of them. It has, however, been confirmed by so many experiments instituted by many different individuals, that no unprejudiced mind can withhold its assent from its truth. Extraordinary, however, as this fact is, it is not more so than many others which have not attracted our particular notice, merely because they are familiar to us. "If we preserve the seed of a plant," says Feburier, "for a series of years, and supply it with different nourishment and soil, and bestow upon it different treatment from that which was destined for it by nature, we destroy its powers of fecundity; the flower no longer possesses pistils or stamina, petals replace them, and announce the sterility of the plant." Something analogous to this holds true, it is said, in the case of one of our domestic quadrupeds. We find the twin-calf, stinted as it has been for room in the ovarium of its mother, and the recipient of but half the nourishment which would otherwise have fallen to its share, becomes in after years a barren cow. In the case of the bee, "the egg of a worker, placed in a royal cell, only produces an insect which has its powers more fully developed, in proportion to the ampler space which it occupies, but it acquires *no new powers*. The germ of the ovary

existed originally in the *common bee* as well as in the *mother-bee,* but the confined limits of its cell, and the want of the peculiar food provided for the royal race prevented its developement."

The proceedings of the bees in order to supply the loss of their Queen, are extremely interesting. In about twenty-four hours they are aware of the misfortune that has befallen them, and, without loss of time, they set about repairing the disaster. They fix upon a worm not more than three days old, demolish the three contiguous cells, and raise around it a regular cylindrical inclosure. At the end of three days, the workers change the direction of the cell, which has hitherto been horizontal, into a perpendicular position, working downwards till it assume the appearance of a stalactite. In due time it is sealed, and the larva undergoes its metamorphosis into a royal nymph. Huber gives a detail of some interesting experiments on this head, the substance only of which we can present to our readers. He deprived a hive of its Queen, and put into it some pieces of comb containing worker eggs. The same day several cells were enlarged by the bees, and converted into royal cells, and the larvæ supplied with a profusion of jelly. He then removed these worms from the royal cells, and substituted for them as many common worms from workers' cells. The bees did not seem aware of the change, they watched over the new worms as intently as over those chosen by themselves; they continued enlarging the cells, and closed them at the usual time. At the proper time, two Queens were hatched, almost

at the same moment, of the largest size, and well formed in every respect. Nothing could be more conclusive than this experiment. It demonstrated that bees have the power of converting the worms of workers into Queens, since they succeeded in procuring them by operating on worms not chosen by themselves, but selected for them.

In addition to this conclusive experiment, we shall take the liberty of detailing two of our own on the same subject, which were made nearly twenty years ago, and which we have repeated almost every year since with the same success. We give these experiments not from any idea that those of Huber require confirmation, or that ours are of importance enough to supply any such supposed deficiency, but on the obvious principle that the more numerous the experiments, and the greater the diversity of experimenters, the more irrefragably is the alleged fact established, if the result be uniformly the same. In June 1822, we instituted an experiment with a view of witnessing a combat between two queens, and the result as to that object will be afterwards noticed. It was only incidentally that we derived from it a confirmation of the fact in question, and we shall now state the particulars. Into a hive well peopled, but not possessing, as far as we could discern, any very young brood, we introduced a stranger-queen, with the expectation that the two rival potentates, each of whom, like the jealous Turk, can bear no rival near her throne, would decide by single combat which of them should retain the honours and privileges of

royalty. We contemplated the possibility of both falling in the conflict at the same moment—an instance of such a calamity having come to our knowledge—and therefore with a view of remedying such an evil, if it should occur, and thus of preventing the total destruction of the hive, we took a piece of comb from another hive, containing worker eggs, and worms of the proper age, according to the directions of Huber, and fixed it in the experimental hive, that the bees might rear for themselves a new queen, should the combat terminate with a double death. To our astonishment, for at this time both queens were alive, we saw the bees next morning busily occupied in building a royal cell in the new piece of comb. They had demolished two or three cells adjoining the one they had pitched on for the royal cradle, and were now eagerly labouring at its enlargement, giving it a circular instead of a hexagonal form, and bestowing unceasing attention on the larva it contained. During the day the royal cell made considerable progress, and in the afternoon of the day following, it extended about half an inch vertically. Next day, it advanced rapidly; the worm had attained to a great size, and the bees were unwearied in feeding it. On the fifth day, the cell was sealed, and on the fourteenth a young queen was hatched; but her enjoyment of life and liberty was very short. She was instantly surrounded by a mass of bees, who hemmed her in so closely, that but a very small part of her body was visible. She made many painful and unavailing struggles to escape, and emitted every minute a plaintive sound. All the while, the reigning queen (for the

stranger had by this time been dispatched, though not in our sight) occupied herself in laying eggs, often within an inch or two of the prisoner, going about her avocations with as much unconcern as if she knew that her subjects would, of themselves, soon and effectually rid her of her puny rival. In two hours from her birth, accordingly, the body of the young queen dropped lifeless from the dense mass of her inexorable guards.

Of the other experiment which we are now to detail, the sole object was to prove the existence of the power inherent in the Bees of rearing an artificial queen, when deprived by any accident of their original mother. This, indeed, had been proved by the experiment above detailed, but only incidentally; and we were anxious, by an experiment instituted exclusively for that object, and conducted with minute and scrupulous accuracy, to put the matter out of all doubt in our own mind at least. In July, our experimental hive was full of bees, brood and honey; the Queen was very fertile, and laying at the rate of more than 100 eggs a-day. We opened the hive and carried her off. For about eighteen hours the bees continued their labours as earnestly and contentedly as if she were still with them. At the end of that time, they became aware of their loss, and all was instantly agitation and tumult; the bees hurried backwards and forwards over the comb with a loud noise, rushed in crowds to the door and out of the hive, as if going to swarm; and, in short, exhibited all the symptoms of bereavement and despair. Next morning, they had laid the foundations of five royal cells, having demolished the three cells contiguous to each of those

containing eggs or worms, which suited their purpose; and by the afternoon, there were visible the rudiments of four more royal cells, all in quarters of the comb where before were nothing but eggs and common larvæ, of one or two days old. Two of these royal cells advanced more rapidly than the rest, probably from the larvæ being of an age the fittest for the purpose; four came on more slowly, and three made no progress after the third day. On the seventh day, the two first were sealed, two more were nearly so, but neither these last nor any of the rest advanced farther, as if the bees, satisfied that they had secured at least *one* queen, judged it unnecessary to carry forward the others to maturity. On the morning of the fourteenth day, from the removal of the old queen, a young one emerged from her cell, strong and active, and exactly resembling those produced in the natural way. While watching her motions, I saw her hasten to the other royal cell, and attempt to tear it open, doubtless with the intention of killing its inmate; but the workers pulled her violently back, and continued to do so as often as she renewed the assault. At every repulse she assumed a sulky attitude, and emitted the shrill monotonous *peep, peep, peep,* so well known to Bee-masters, while the unhatched queen emitted the same kind of sound, but in a hoarser tone, the consequence of her confined situation; and this, by the way, accounts for the two different sounds which are generally heard from a hive on the eve of throwing a second swarm. The shrill sound proceeds from the reigning queen, and

seems to express her rage and disappointment at being baffled by the watchful guardians of the unhatched queen, from whom the hoarse sound comes. In the afternoon of the same day, the last mentioned female left her cell. We saw her come forth in majesty, finely and delicately formed, but smaller than the other. She immediately retired within a cluster of workers, and we lost sight of her. Next morning on opening the shutter of the hive, we perceived the younger queen rushing apparently in great terror across the surface of the comb, and hurrying round the edge of it to the other side; and in the next moment, the other royal personage came in sight, hotly pursuing her rival. We now fully expected to witness Huber's combat of queens, and were about to wheel round the hive on its pivot, to contemplate the fray, when business called us away. In half an hour we returned, hoping we might be in time, but all was over! the younger queen was lying upon the alighting-board on her back, in the pangs of death, newly dragged out by the bees, and doubtless the victim of her jealous senior.

We observed two circumstances respecting these artificial queens, which may be noticed here, though rather, perhaps, out of place—one of them agreeing perfectly with the experience of Huber, while the other is at variance with it. While the surviving queen remained a virgin, not the slightest mark of attention or respect was shewn to her by the bees; no one gave her food, she was obliged as often as she required it, to help herself, and in crossing

to the honey cells for that purpose, she had to scramble, often with great difficulty, over the crowd, not an individual of which got out of her way, or seemed to care whether she fed or starved. But no sooner did she become a mother than the scene was changed indeed, and all vied in testifying their affection and regard; one after another presented her proboscis with food, and at every step of her progress, a circle was formed around her by her admiring subjects. The other circumstance alluded to, which varies from the experience of Huber, respects the vigilance of the workers in such cases, and the sound emitted by the queens. He says, that the workers form no guard around the cells of artificial queens, and that these last are perfectly mute; and the Naturalist makes some remarks by way of accounting for it.* The above experiment is completely in contradiction to this. The cell of the younger queen was most strictly guarded, and both emitted the sounds alluded to, perhaps once every minute, for several hours together.—To these experiments we have only to add farther, that, as already stated, we have very frequently repeated the same operation, and always with success; and that in the summer of 1832, we removed the reigning queen of the same experimental hive three times successively, suffering each queen to remain just long enough to lay a score or two of eggs before her removal; and each time the workers laid the foundations of five or six royal cells, and brought two or three Queens to

* Huber, p. 131.

maturity. Within the space of six weeks, we saw the foundations laid of fourteen or fifteen royal cells, and at the last removal, no fewer than three Queens were visible at the same moment on the surface of the comb; yet we had not the good fortune to witness a regular combat between any two of them. The first hatched of the three, we had reason to conclude, dispatched two of her rivals, but without our witnessing the deed of death. The third we saw her sting repeatedly, at the instant of the former emerging from her cell, and without any attempt on the part of the bees to restrain her. The wounded Queen had strength enough to move a few inches across the comb, when she paused, and seemed to sicken from the effects of the venom; she moved again, with a very languid step, an inch or two, and then stopped; her limbs became visibly paralyzed, and in a few minutes she dropped lifeless to the bottom of the hive. —From all these experiments, it seems now a fact established beyond all doubt, that Bees can at all times procure a Queen for themselves, provided they have a comb containing larvæ not more than three days old, in the common cells, and that nothing but certain important conditions, such as a particular kind of food and more spacious lodgment, are requisite for the conversion of common larvæ into Queens.

At the same time, it ought to be candidly confessed, that while the fact itself seems now completely established, there are circumstances connected with it which we are unable satisfactorily to explain. That a more abundant supply of food, and

of a more stimulant quality, administered in a cell of larger dimensions, should give full development to organs which, by the ordinary treatment, would have remained but partially expanded, we can readily comprehend; but that such extra supplies of food and space should effect an absolute change in the anatomical structure and instinctive propensities,—should produce a more slender proboscis, deprive the transformed insect of the downy brushes at the joints of her limbs, and of the basket-shaped cavities in the posterior pair, for retaining the pellets of farina,—and, above all, should effect so great an alteration in her instincts, rendering them in numerous particulars entirely different from those of the worker class, for which she was originally destined,—these are circumstances which, notwithstanding all our researches, are still involved in mysterious obscurity, and furnish ample scope for future investigation.

On the Architecture of Bees.—The peculiarities of instinct in the different orders of animals, if pursued through all its variations, would supply us with an inexhaustible fund of admiration and instruction; and in none of the lower animals is this wonderful faculty more worthy of our notice and investigation than in the Bee. So much, however, has been already written on this particular point, that the subject is pretty nearly exhausted. We should perhaps find, notwithstanding, but little difficulty in treating our readers with an additional disquisition on the same subject, but as we do not pretend to be able to give a more satisfactory elucidation of the mystery of

animal instinct than has been already furnished by writers* well entitled to our respect, we shall restrict ourselves to one or two brief remarks having a special reference to the subject of this chapter. It has been said of Instinct generally, that, taken the least out of its way, it seems an undistinguishing, limited faculty, and blind to any circumstance that does not immediately respect self-preservation, or lead at once to the propagation or support of the species. As far as the instinct of Bees is concerned, this maxim must be taken in a qualified sense; for there are numerous instances in the proceedings of this insect in which instinct *does* vary, and conform to the circumstances of place and convenience; and in no part of their economy do we see more striking instances of this half-reasoning faculty than in their Architecture. In the ordinary operations of collecting their food, feeding their young, following their queen, &c. they are prompted, doubtless, by pure and simple instinct. In avoiding danger, and in returning to the spot where food had formerly been provided for them, they seem guided by an exertion of memory, a faculty which they appear to possess in a considerable degree. But in adapting their waxen structures to change of circumstances, and so as to overcome any artificial obstacle,—in building *upwards*, contrary to their natural mode of procedure,—in building *laterally*, when unable to find a sure foundation for their works, either above or below,—in *curving* their combs, and constructing them *angularly*, when de-

*See Bonnet, Huber, Virey, Kirby and Spence, Bevan, &c.

sirous of avoiding some interposing substance having a smooth or glassy surface,—these are results which seem to manifest something more than simple instinct; they afford a wonderful proof of the resources of this faculty, when compelled to deviate from the ordinary course; they imply, in fact, the possession of a certain degree of intellect, or of reasoning power, by which their instinct is modified and counteracted. We cannot, indeed, but be filled with astonishment, when we see their ingenious expedients in getting the better of difficulties, which would not have occurred in their natural state,—and with admiration of the wisdom and goodness of the Almighty Parent, so conspicuously visible, even in the unconscious instinctive operations of these tiny creatures of his hand.

The material of which the bees construct those beautiful combs, which deserve so much admiration, is Wax—the nature and production of which will be considered in a subsequent chapter. No sooner has a swarm been safely lodged in a hive, than the industrious labourers commence the operation of building. One portion of the population employs itself in cleaning out their new abode, whilst a large number hastens to the fields, some of them to collect honey, the saccharine part of which is the source of the wax used in the construction of the combs,—and others to gather propolis, which is a tenacious substance employed in fixing the less adhesive wax to the roof of the hive, and in stopping up any crevices that might give entrance to vermin, or admit the cold.

On their return, those bees which have been occupied in collecting honey, cluster closely together at the top of the hive, and, suspended from each other by their hooked claws, form a variety of fantastical and often graceful figures, festoons, curtains, ladders, &c., crossing each other in all directions, (Pl. V.), and seem sunk in a profound inactivity, which continues about twenty-four hours. The inactivity, however, is only apparent. The time which they pass in this seeming repose is doubtless necessary for the elaboration of the honey, and the transfusion of the saccharine part in the form of wax. But in the centre of the mass, one worker has left its fellows, and laid the foundation of the future structure ; it is succeeded by several others, each of whom, singly and separately, contributes its quantum of material and skill to the rising edifice, while succeeding bands of nurse-bees busy themselves in finishing and polishing the work, which the wax-workers have only rough hewn. For it is to be observed, that in the construction of the combs, the two classes of *wax-workers* and *nurse-bees* have their separate and distinct provinces. That of the former is to supply the rough materials, and attach them coarsely together ; and that of the latter to finish and perfect the edifice. And while these last are occupied in this more refined operation of finishing and polishing, the former, like industrious labourers, are continually bringing forward additional loads of materials. One comb is scarcely begun, or contains not more than two or three rows of cells, when the busy architects proceed

to lay the foundations of two others, one on each side of that already founded, continuing their operations in this manner, till they have taken in the whole range of their building ground; and, with such diligence do they ply their labours, that in one day, during the height of the honey-season, they will construct no fewer than 4000 cells. A comb measures in thickness, generally speaking, one inch, and the interval between them is about one third of an inch, affording a passage for two bees, back to back, without obstruction or inconvenience. These dimensions, however, are varied according to circumstances. Towards the top of the hive, (Pl. VI. fig. 1, *a*, *a*,) where the honey magazines are situated, the cells are deepened, consequently the thickness of the comb is increased, and the road-way contracted. This is no inconvenience to the bees, for, after the honey-cells are sealed, they have seldom occasion to visit that quarter of the hive, and can, therefore, put up with less room.

When the breeding season returns, however, these cells are all reduced to their original size, if emptied of their contents, and thus fitted for the reception of brood. The combs, attached as they are to the roof of the hive, descend vertically. Unlike human builders, they begin their work at the top or ceiling, and suspend their structures from above. This is their usual mode of proceeding, but circumstances induce them sometimes to vary it. The following is an instance from our personal observation: We put a swarm into our experimental hive, which is so thin, as to admit of one comb only being constructed.

Its confined limits prevented any considerable number of bees from working at the foundation of the comb above. A large portion of them, therefore, began a comb, or rather two, (Pl. XV. Fig. 2, *a, b,*) on the rod which crosses the hive in the middle; and thus two combs were being constructed at the same time, and which ultimately became one. It appeared, however, that there was still a want of room, and of employment for these willing and industrious labourers; for to our surprise a portion of them began a comb (*d, e,*) on the *upper side* of the cross rod, and, contrary to their natural mode of proceeding, worked upwards; so that in a short period, the upper comb and the central piece met, and the whole formed ultimately one solid square. The surface of a new comb is not quite flat, but lenticular, that is, its thickness decreases towards the edges, and, consequently, the latest made cells are shorter or shallower than the others. So long as the comb has not reached its utmost limits, this shape is preserved; but when the bees have no more room for its enlargement, they make all the cells of equal depth, and thus it obtains two flat and straight surfaces, which it will continue to retain, unless in certain circumstances. Should it be broken by any means, the edges of what remains must be reduced again to their lenticular shape before the bees can repair the structure, and prolong it to its former dimensions.* This happens also when the hive is enlarged, by giving it what is called in Scotland an *eek*, or addition

* Huber, 372.

below. Previous to availing themselves of the added room, the bees reduce the thickness of the edges of the combs. When new, the combs are of a remarkably pure white colour, but soon assume a yellowish hue, and when a year old, are of a deep brown. This discoloration is believed by many to arise from the vapours and heated air of the hive; but is attributed by Huber, erroneously we think, to some direct action on the part of the Bees, which are frequently seen rubbing the surface of the comb with their teeth and fore-feet. In the construction of the cells, the Bees adopt the hexagonal form, (Pl. VI. Fig. 1, *b*, *b*,) consisting of six equal sides, and begin their operations at the bottom, prolonging by degrees the pannels or sides. The bottom of a cell is composed of three rhombs, or plates of wax in the shape of lozenges or of card-diamonds, and disposed in such a manner as to form a hollow pyramid. "The apex of each pyramidal bottom, on one side of a comb, forms the angles of the bases of three cells on the opposite side, the three lozenges respectively concurring in the formation of the bases of the same cells."* The whole structure is so delicately thin, that three or four of the sides, placed upon one another, have no more thickness than a leaf of common paper. But by the admirable disposition and arrangement of its parts, "each cell, separately weak, is strengthened by coincidence with others. The bottom of each cell rests upon three partitions or pannels of opposite cells, from which it receives a great accession of

* Bevan on the Honey-Bee, 2*d Edit.* p. 391.

strength." Besides, each cell is strengthened at its mouth by a strong thread formed of a mixture of wax and propolis, soldered to the inner edges, and giving it, by filling up the angles, a circular form. This gives great solidity to the fabric, and prevents the mouths of the cells from being easily injured by the unceasing ingress and egress of the bees.

It is remarkable that the cell of a honey-comb, including its hexagonal sides and its pyramidal basis, is the figure, of all others, the best adapted for containing the greatest possible quantity, in the least possible space, and with the least expense of material. "There are only three possible figures of the cells," says Dr. Reid, "which can make them all equal and similar without any useless interstices. These are the equilateral triangle, the square, and the regular hexagon." Of these, the hexagon is the best fitted for the bee-cell, for it unites to the requisites stated by Dr. Reid, economy of material, and a figure better adapted to the shape of the insect. This last property would have been possessed in a greater degree by the cylindrical form, but it would have left a vacant space between every three contiguous cells. The square and the triangle would have left no interstices, but would have consumed more wax, and been ill-adapted to the shape of the bee. The hexagonal form employed combines all the requisites; for, together with a convenient figure for the reception of the body of the insect, it secures economy of material and economy of space, both as respects the number of

cells contained in a comb, and the internal capacity of each. The same, or, if possible, still more admirable skill and arrangement are displayed in the basis of the cell. The three rhombuses of which it is composed, have the two obtuse angles each of 110 degrees, and, consequently, each of the two acute angles of 70 degrees. This measurement was taken by Maraldi, and it was verified by Koenig, a celebrated mathematician and pupil of Bernouilli, who, on being desired by Reaumur to calculate the quantity that should be given to this angle in order to employ the least wax possible in a cell of the same capacity, found that the angle in question ought to be 109° 26′ or 110° nearly, the very angle which the insect adopts. What a surprising agreement! A difficult mathematical problem is proposed for solution to a man of profound science, and it is found that an insect, "little among such as fly," instructed by the Fountain of Wisdom, has anticipated the calculations of the Geometer, and practically exhibited in its waxen structures the same conclusion precisely which the philosopher arrived at, only by the exercise of considerable ingenuity, and deep thought! The calculation has also been verified by our distinguished countryman Maclaurin, who very justly observes, that "the bees do truly construct their cells of the best figure, not only *nearly*, but with exactness, and that their proceedings could not have been more perfect from the greatest knowledge of geometry." After all, as Dr. Reid remarks, the geometry is not

in the bee, but in the Geometrician who made the bee, and made all things in number, weight, and measure.

The cells in a honey-comb are of different dimensions, corresponding to the different classes of bees, of which they form the birth-place. Those of the workers (Pl. VI. fig. 1, *c*, *c*,) are in depth about five lines, or less than half an inch, and in diameter $2\frac{2}{5}$ lines; those of the males (*d*, *d*, *d*,) are between six and seven lines in depth, and $3\frac{1}{5}$ in diameter. Both of these are ultimately employed, after the breeding season is past, as receptacles for honey. The male, or drone cells are few compared with those of workers, which last generally compose the whole of the central combs, while the first are most frequently constructed on the extremities of combs at some distance from the centre.

It is curious to note the proceedings of the bees when about to pass from the construction of worker-cells to those of males. They do not all at once commence the latter of their full diameter; such a proceeding would utterly disorder the delicate arrangement of the bases of the cells. But they build a few rows of intermediate cells, whose diameter augments progressively, until they gain the proportion proper to the cells required. And in returning to those of workers, a similar gradation is rigidly observed. The irregularity apparent in these transition cells has been accounted a defect. It is, on the contrary, an additional instance of that wise instinct which teaches them to quit the ordinary mode of proceeding, when

circumstances demand the construction of enlarged cells, and after building 30 or 40 rows of them, to return to the proper proportions from which they have departed, by successive reductions. Both of these kinds of cells being nearly horizontal, it may seem surprising that they can be filled with, and retain, the honey-fluid. The fact is, however, that they are not horizontal, but are elevated at an angle of never less than 5°, and sometimes when the honey is rendered peculiarly thin and fluid by the warmth of the season, at not less than from 15° to 20° above the level of the horizon. We have often observed in the months of July and August, when the weather was very favourable for the secretion of honey and wax, the bees eagerly engaged in forming cells designed for honey only, and differing considerably from those which are intended in the first instance for the reception of eggs. The texture of the former is thinner, and their depth much greater; and as the honey is at this period of the year of a rarer and more fluid quality, these cells are by a wise instinct made with a much greater dip or inclination than the ordinary ones, that there may be less risk of the liquid running out before they are sealed. Doubtless, also, the honey is prevented from escaping, partly by its own viscosity, and partly by the force of capillary attraction. For if we carefully examine a cell when nearly full, it will be observed that the surface of the fluid is considerably concave, from its adhesion to the sides of the cell. It will also be observed how ingeniously the bees seal up their trea-

sures. They first form a ring of wax around the inside of the mouth of the cell; to this first ring, additional ones are applied as the increased deposit of honey renders necessary, till at last the opening is completely sealed up by a succession of concentric rings. Besides the cells of workers and males, we find, during the swarming season, other cells, to the number of six, eight, ten, or twelve, differing altogether from those first mentioned. These are the royal cells, the cradles of the infant queens. (Pl. VI. fig. 1, *e, e.*) They are found always on the edges of the combs, of such particularly as extend but halfway across the interior. These cells are constructed not entirely of wax, Mr. Hunter thinks, but of a mixture of that substance with farina. Their position is almost vertical, and somewhat resembling a hanging acorn; their dimensions about one inch in length, and $3\frac{1}{2}$ lines in diameter. "Their oblong cylindrical form, smoothly polished within, and covered externally with a kind of fret-work, gives them the resemblance of a suspended stalactite, and announces a particular destination. In fact, the imposing appearance of this cradle, and the profusion of materials expended on it, which is such, that one of them outweighs 100 common cells, point it out as destined for receiving and rearing the most important personage of the colony—the mother and queen." *

In the architectural operations of bees, the *modus operandi* has been minutely detailed in the writings of Huber. His observations and experiments on this

* Feburier, Traité des Abeilles.

branch of their natural history are calculated to excite the deepest interest, and we regret that our limits oblige us to forego the pleasure of reciting them, and to refer our readers to the original work. We cannot, however, omit one extract from his observations, which strikingly proves that though the bees, when left to themselves, regulate their operations with perfect uniformity, they are yet capable of modifying them in particular circumstances. "Having seen bees," says he, "work both upwards and downwards, we wished to investigate whether we could compel them to construct their combs in any other direction. We tried to confound them with a hive glazed above and below, so that they had no place of support but the upright sides of their dwelling; lodging themselves in the upper angle, they built their combs perpendicular to one of these sides, and as regularly as those which they usually build under a horizontal surface. I put them to a still greater trial: As they now testified their inclination to carry their combs in the shortest way to the opposite side of the hive,—for they prefer uniting them to wood, or a surface rougher than glass, —I covered it with a pane of this last mentioned material. Whenever this smooth and slippery substance was interposed between them and the wood, they departed from the straight line hitherto followed, and bent the structure of their comb at a right angle to what was already made, so that the prolongation of the extremity might reach another side of the hive which had been left free. Varying this experiment after several fashions, I saw the bees constantly change

the direction of their combs, when I approximated a surface too smooth to admit of their clustering on it. They always sought the wooden sides. I thus compelled them to curve the combs in the strangest shapes, by placing a pane of glass at a certain distance from their edges. These results indicate a degree of instinct truly wonderful. They denote even more than instinct; for glass is not a substance against which bees can be warned by nature. In trees, their natural abode, there is nothing that resembles it, or with the same polish. The most singular part of their proceeding is changing the direction of the work, *before arriving at the surface of the glass,* and while yet at a distance suitable for doing so. Do they anticipate the inconvenience which would attend any other mode of building? No less curious is the plan adopted by the bees for producing an angle in the combs; the wonted fashion of the work, and the dimensions of the cells, must be altered. Therefore, the cells on the upper or convex side of the comb are enlarged; they are constructed of three or four times the width of those on the opposite surface. How can so many insects, occupied at once on the edges of the combs, concur in giving them a common curvature from one extremity to the other? How do they resolve on establishing cells so small on one side, while dimensions so enlarged are bestowed on those of the other? And is it not still more singular that they have the art of making a correspondence between cells of such reciprocal discrepance? The bottom being common to both, the tubes alone assume a taper form. Per-

haps no other insect has afforded a more decisive proof of the resources of instinct, when compelled to deviate from the ordinary course."

It is singular that though the construction of the cells of a honey-comb, so geometrically just, and so well adapted to produce the greatest capacity, at the least possible expense of superficial extent or of materials, has been long an object of general admiration; one Naturalist, and that of no mean celebrity, affects to disdain partaking of this almost universal feeling. Buffon, as if to evince his superiority to what he considers the vulgar enthusiasm excited by the architecture of the bees, declares that "these bee-cells—these hexagons so much applauded and admired, serve only to furnish us with a new argument against enthusiasm and admiration. This figure, correctly regular and geometrical as it appears to us, and as it actually is in theory, is, in this instance, but the effect of a mechanical result, which is often found in nature, and may be observed even in the most inanimate productions. Crystals, and several other stones, and some kinds of salts, assume constantly this figure in their confirmation. Let a vessel be filled with peas, or rather with some seeds of a cylindrical shape, and let it be closely shut, after having first poured in a sufficient quantity of water to fill up all the intervals between the seeds; let this water be boiled, and all the cylindrical seeds will become columns of six sides. The cause, it is evident, is purely mechanical. Every cylinder-shaped seed tends, by its swelling, to occupy the greatest possible space in a

given space; they become, therefore, necessarily hexagons by reciprocal compression. In like manner, every bee seeks to occupy the greatest possible room in a given space; it is therefore necessary here also, since the body of the bee is cylindrical, that their cells should be cylindrical, by reason of the same reciprocal compression."

To this reasoning it may be answered, that there is no analogy between the cases. A hive without comb, as Lombard argues, is not above one-fourth filled with bees; and there is no cover, as in the case of the vessel, to keep the mass together. To make the cases perfectly similar, and fit subjects of comparison, the vessel with water ought to be filled but to the extent of one-fourth; and in that case, the cylindrical seeds will not be converted into hexagons. Besides, the cells at the extremities of the combs, though not so deep as those at the centre, are as exactly hexagonal in their forms. Now, if hexagons are formed by the reciprocal impression of the bodies of the bees against each other, how does it happen that the cells at the extremities, which are not attached to the sides or bottom of the hive, and where, consequently, there can be no reciprocal compression, should yet be as perfect hexagons as the rest? And, not to dwell on other proofs adduced by Lombard and other writers, of the utter insignificancy of this naturalist's theory—the cells have not all the same figure, the same dimensions, depth, and diameter, which they would necessarily have, if they had been produced merely by reciprocal compression. No;

the works of the Bee demonstrate an intelligence, or, if we please, an instinct superior to that of most animals; and what is this instinct but the teaching of the Almighty—a manifestation, even in the organization of a creature so unimportant as a tiny fly—of his eternal wisdom, which can render an insect of the earth an object of wonder to man himself, with all his boasted endowments; and which, while it guides the planets in their courses, and sustains and upholds innumerable myriads of rational and immortal beings, directs the minutest animalcule to do those things that are necessary to the preservation and comfort of its existence.

On the different substances found in a hive—Honey, Wax, Farina or Pollen, and Propolis.—Honey is well known to be a vegetable product, secreted in the nectaries at the base of the corollæ of flowers. It has been supposed by some writers to be the elemental principle of all vegetables, without exception, and indispensable to their existence; although there is, perhaps, no sufficient evidence of the saccharine matter of plants being in all cases convertible into honey. As one of its secondary uses, it seems destined by nature for the food of bees; and these industrious collectors fail not to appropriate the rich liquid. Sweeping the hollow of the honey-cup with their little probosces, the little skilful chemists eagerly imbibe the saccharine juices as they exude from the nectarium, receive them into the globular honey-bag, which forms their anterior stomach, and hurrying homewards with their precious load, dis-

gorge it into the cells prepared for its reception. The quantity which each bee deposits at one time is very small, the honey-bag when full not exceeding the size of a pea; but the aggregate quantity collected by the whole population is prodigious. We have, in a fine summer day, repeatedly counted the bees of a hive as they return from the fields laden with sweets, and found the number to be between sixty and seventy in a minute. When the cell is full, it is carefully sealed with a waxen cover, and reserved for use in winter and spring, particularly in the latter season; for more honey is consumed in the months of March and April, when breeding goes on actively, than during the four preceding months. At the same time, many cells are left open and half-filled only, for daily consumption. It has been a subject of discussion among Naturalists, whether the honey, after being extracted from the flowers, undergoes any change in the stomach of the insect before being deposited in the cell. Feburier is of opinion that it is subjected to the digestive process. The celebrated John Hunter thought it remained pure, and in no respect whatever altered, however long it had been retained in the stomach of the bee; and he is followed in this conclusion by his countryman, Bonner. Kirby and Spence, entomologists of no mean fame, have adopted the opposite opinion; but it does not appear that they had been led to this conclusion by the result of any experiment instituted for the purpose of deciding the matter. Reaumur, however, tells us, that from his experiments, he was satisfied that a process of

elaboration does take place in the food with which he had supplied his bees; and that the sugar with which he fed them had precisely the taste and flavour of honey. Our experience, if we may venture to differ in the matter from men so deservedly celebrated for attainments in natural science, leads us, with Hunter and Bonner, to a different conclusion. We have repeatedly tasted the syrup of sugar, which we had seen the bees taking from the feeding-trough, and depositing in the cells, and could never discover the slightest difference in any respect, at least so far as taste and flavour are concerned. Perhaps the liquid was clearer—we sometimes imagined it was—if so, this constituted the only difference.

The secretion of honey depends greatly on the state of the atmosphere. During the prevalence of dry easterly winds, the fields present to the bees nothing but barrenness; their out-door labours are suspended, and but for the already hoarded stores, the brood would be in imminent danger of starvation. But when the weather is moist and sultry, and the air charged with electricity, the circulation of this vegetable fluid is considerably accelerated, and the bees know well how to avail themselves of so favourable a juncture for collecting their treasure. Huber remarks, that the collection is never more abundant nor their operations in wax more active, than when the wind is from the south, the air moist and warm, and a storm approaching. Heat too long protracted, however, and its concomitant drought,—chill rains and a north wind, entirely suspend the elaboration of

honey in vegetables, and consequently the operations of the bees. The quality of the saccharine fluid is influenced by various causes. Something depends on the particular period of the season in which it is collected. In Scotland, the best honey is gathered in the months of June and July, when the white clover (*Trifolium repens,*) is in bloom; and what is stored in spring, or rather in April and May, is purer and better flavoured than what is obtained in autumn, unless the bees have been during the latter season within reach of heath, the honey from which is of a rich wild flavour, but of a darker colour. The quality of honey is, of course, much influenced by the nature of the plants most frequented by the bees. The famed honey of Hymettus derives its excellence, it is said, from the wild thyme growing so luxuriantly on the celebrated mountain from which it derives its name; that of Narbonne, from the wild rosemary (*Rosmarinus officinalis.*) The white Dutch clover, and the heath have been already noticed as furnishing honey of a superior kind; and there is a district in Galloway, North Britain, where perhaps the best honey in the kingdom is produced, owing, it is supposed, to the great abundance of wild thyme (*Thymus serpyllum,*) with which the country abounds.

Instances of honey of a deleterious nature being sometimes met with, have been already noticed, (p. 49.) We have seen it remarked, in Bee-publications, that the finest honey is got from young swarms; the fact is so, generally speaking, but not, as we might naturally be led to infer from the asser-

tion, because it is the produce of young bees or of fresh swarms, but because bees swarm only at the height of the honey-season, when the flowers are in their richest fragrance, and because the combs are then new, and have not as yet served as receptacles for the brood. The above remarks apply to the quality of the honey in the state in which it is secreted in the flowers; its after-treatment does not improve it. The heat and vapour of the hive are injurious to it; in very severe seasons it is sometimes candied; and in the honey-harvest, when it is being separated from the wax, its purity may easily be injured by imperfect management.

As an article of nourishment to man, honey has been highly valued from time immemorial, whether used separately, or blended with other aliments. It was held out to the children of Israel as one of the valuable products of the promised land; and to this day it is in high estimation in Eastern countries. Among the Greeks and Romans it was highly relished; they compounded it with many other nourishing substances, and even mixed it with their wines. It is nutritious in proportion to the saccharine matter it contains, and is regarded by medical men as a good stomachic.* Its use as an article of food has been greatly diminished by the culture of the sugar-cane; but it is still an article of very considerable traffic, and large quantities are imported into this country annually, both from the European continent and from America. It forms, we are told, a very im-

* Feburier.

portant ingredient in those fine ales which are brewed in Scotland; and certainly it must add not a little to the nutritive qualities of that wholesome beverage.

It will not, perhaps, be considered out of place to take notice here of the Honey-dew. When the close of summer happens to be hot and sultry, and the air calm, the bees find a large supply of food on the leaves of certain plants and trees. This is the honey-dew. It is believed, generally, to be an exudation of the surplus sap of trees, by means of the pores of the upper surface of the leaves; and is most frequently found in the oak, the elm, the plane, the lime, and the beech, and also in many fruit-trees and ever-green plants. The idea has been entertained of its falling from the atmosphere; and perhaps the supposition is, in a certain sense, not altogether without foundation, nor inconsistent with the notion of its being originally a vegetable exudation. Certain it is that, in very sultry evenings, we have observed not only the leaves of trees shining with the liquid, but the dry stones also and gravel completely bespotted with it, as if it had fallen in a gentle shower or dew. White of Selbourne regarded it as the effluvia of flowers, evaporated and drawn up into the atmosphere by the heat of the weather, and falling down again in the night with the dews that entangle them. Curtis* is of opinion that it is neither an exudation of the sap of trees, nor falls from the atmosphere, but that the true and only source of this saccharine matter is to be found in the insect Aphis, or vine-

* Linnæan Transactions, vol. vi. page 75.

fretter. That a species of honey-dew is secreted by the Aphides, there can be no doubt; but that in these insects we are to look for its exclusive source, is a proposition we do not think borne out by facts. "If it fell from the atmosphere," says Curtis, "it would cover every thing on which it fell *indiscriminately*; whereas, we *never find it* but on certain living plants and trees." The proposition in the beginning of this quotation we readily accede to; the assertion at its close we can contradict from personal observation. We have, as already stated, seen the dry stones and gravel walks in the neighbourhood of plantations completely spotted with the liquid in a sultry summer evening; and this, be it observed, not immediately under the trees, so as to warrant the supposition that it had been projected there by the aphides above, but at the distance of many yards from any plant or tree on which the insects might have taken their station. Curtis maintains, also, that "though *wasps* are partial to this food, *bees* appear totally to disregard it." He is surely mistaken in this. During the continuance of honey-dew, every oak, elm, plane, and lime tree is literally covered with these insects; and the observer has only to bring the tip of his tongue in contact with one of the leaves, to be convinced that the honey-dew is there, and that this is the great attraction to the bees, which are eagerly availing themselves of the liquid treasure, and expressing their delight in the joyous hum that is heard over head. The most obvious way, perhaps, of reconciling such well-known facts with the

opinions and observations of the distinguished Naturalist alluded to, is, that he applies the term *honey-dew*, not to the saccharine fluid that transudes through the leaves of certain trees, but exclusively to the excrementitious matter deposited on them by the aphides. Assuming, then, that there are two kinds of honey-dew, one only of which is spoken of by Curtis, the following appears to us to be the *rationale* of the matter. Honey-dew, in whatever mode obtained, is the saccharine juice or sap of vegetables, indispensable to their vitality. During extreme heats it exudes through the pores of the upper surface of the leaves. In this state it may be exhaled during the sultry heat of the day, and fall again in the form of condensed vapour in the night; while what is secreted near the time of sunset remains on the leaves till the following morning. And, further, this same vegetable juice is extracted by another process besides the perspiratory,—namely, by the sucker of the aphis inserted into the tender bark of the tree, or into the footstalks of the leaves, and conveyed through the insect's system, and finally discharged almost in its primitive purity, from the abdomen, in liquid jets, unless there are ants at hand. In that case, the precious juice is sucked in by the last-named insects, with an eagerness which strongly testifies their sense of its richness.*

* See P. Huber's Researches concerning Ants.

Since the above was written, the author has met with the following confirmation of his opinion as to the origin of Honey-dew, in the *Quarterly Journal of Agriculture*, *No.* 44, *March* 1839, from the pen of an intelligent contributor to that work :

Wax.—Wax is a vegetable product, deriving its origin from the saccharine principle existing abundantly

—" The honey-dew was noticed by the ancients, and is mentioned by Pliny by the fanciful designation of ' the sweats of the heavens,' and ' the saliva of the stars,' though he questioned whether it is not a deposition from the air, purging this from some contracted impurity. More modern philosophers have been quite as erroneous and discordant in their opinions relative to its nature. Some, with the most unmitigable asperity, declare that it is the excrement of aphides ; others as exclusively maintain that it is an atmospheric deposite ; and a third party consider that it arises from bleeding consequent to the wounds of insects. That there may be a glutinous saccharine liquid found upon the leaves of plants, arising from the first and third named causes, is probable, or rather certain ; but this is by no means conclusive that there is not a similar liquid extravasated upon the surface of the leaves, owing to some unhealthy action of their vessels. It is with this description of honey-dew that we are here concerned. The error into which writers on this subject appear to have fallen, consists in their having endeavoured to assign the origin of every kind of honey-dew to the same cause." After noticing the theories of White and Curtis, the writer goes on to say, " The various successful application of liquids to plants, in order to prevent the occurrence of honey-dew, and similar diseases, would seem to indicate that a morbid state of the sap is the chief cause of the honey-dew : for otherwise it would be difficult to explain the reason why the use of a solution of common salt in water, applied to the *soil* in which a plant is growing, can prevent the appearance of a disease caused by insects. But if we admit that the irregular action of the sap is the cause of the disorder, then we can understand that a portion of salt, introduced into the juices of the plant, would naturally have a tendency to correct or vary any morbid tendency, either correcting the too rapid secretion of sap, stimulating it in promoting its regular formation, or preserving its

in the productions of nature. It is found on the upper surface of the leaves of many trees in the form of a varnish, possessing all the properties of bees-wax. The wax-bearing myrtle, (*Myrica Cerifera,*) a shrub which grows abundantly in Louisiana and other parts of North America, bears a small berry, of which wax forms the outer coating, and which, when exposed to flame, burns with an agreeable aromatic odour. Dr. Darwin supposes that the design of the waxy varnish which covers the flowers is "to glaze over the fecundating dust of the anthers, and prevent its premature explosion from excessive moisture," and ascribes to an unseasonable diffusion of the anther dust, the failure of orchard and corn crops in summers of extreme humidity.

The quantity of wax found in this form is small compared with that which is produced by the honey-bee, and also of inferior quality. When pure, it is of a whitish colour, destitute of taste, and with scarcely any smell; it grows brown and even blackish with age. After manipulation it has an aromatic smell, which, however, disappears on exposure to the atmosphere. The dust of flowers, called pollen or farina, was long supposed to be the element of wax; and it is a curious instance of the tardy progress of the knowledge of natural history, that, though the mode in which wax is produced by the bees was ascertained beyond all doubt by Huber, 40 years ago, the fact is yet little known, and scarcely believed; and farina has, with

fluidity. And that by such treatment, the honey-dew may be entirely prevented, I have often myself witnessed in my own garden," &c.

many, still the credit of being what is called "crude wax." Buffon was of this opinion, and, in an edition of his works published so late as 1821, no notice is taken of the recent discoveries on the subject which prove his opinion to be erroneous. Reaumur was inclined to believe that pollen, by receiving some peculiar elaboration from the bees, was converted in the stomach to real wax, and disgorged under the appearance of paste. Later observers, however, denied that wax was disgorged by the mouth; they affirmed that it exudes from the rings of the abdomen in the form of small scales, and that pollen was used for very different purposes. That this last mentioned substance is not the prime constituent of wax was a conclusion drawn from repeated and accurate observations. It had been observed, for instance, that pollen is carried in great quantities into hives which are already full of comb,—that it is often of various colours, while new combs are always of a pure white,—that fresh swarms for some days carry no pollen, although their first operation after being housed is the construction of combs, the building of which goes on with unremitted rapidity,—and that while it has been calculated that 100 pounds weight of pollen is carried into a hive during the season, the whole wax of a hive, when separated from the honey, weighs something less than two pounds. On the other hand, the evidence is strong that wax derives its origin from honey. It is observed that seasons unproductive in honey are also unproductive in wax, although pollen is at the same time abundant, —that, by the accurate dissections of John Hunter,

the receptacles were discovered where the wax is lodged after its transudation from the body of the bee, —that a vast number of small scales, proved to be wax, are to be seen at the bottom of the hive in which bees have recently been lodged, and which have certainly fallen from them while hurriedly occupied in fixing the foundation of their combs,—and, that these scales have been observed by many, ourselves among the number, appearing under the rings of the abdomen, and more than half extruded. And, finally, these discoveries, which some, perhaps, might regard as little more than presumptive evidence, have been followed up by Huber with his usual success, and the formation of wax from honey or sugar, the saccharine part of which last-mentioned substance constitutes one principal ingredient of honey, established by such unequivocal experiments as to force conviction on the most sceptical. We have again to express our regret that our narrow limits oblige us to give only a very brief abstract of these most interesting and conclusive experiments, and to refer the reader to the ampler details to be found in Huber's work. He lodged a young swarm in a straw hive, furnishing them with honey and water, and confining them for five days; at the end of that period the bees had consumed the whole of their provisions, and had constructed several combs of beautiful wax. These combs were removed and more honey given them, and the result was the same. This removal was made five times successively, and on each occasion, being supplied exclusively with honey, they produced new combs; thus putting it beyond dispute that this sub-

stance effected the secretion of wax in the body of the bee. And further, to ascertain whether the saccharine principle were the real source of wax, he supplied the captive bees with sugar in the form of syrup; the result was still the same; wax was produced, and that in a shorter period, and in greater abundance than from honey. As the reverse of this experiment would prove whether the pollen or farina itself had the same property, instead of supplying the bees with honey or sugar, he fed them only on fruit and farina. They were kept eight days in captivity under a glass bell, with a comb having only farina in the cells, yet they neither made wax, nor were scales seen under the rings.

It is but justice to the Scotch bee-master, Bonner, to remark, that, amidst the errors on the subject which prevailed in his day, he had a strong impression of the real source of wax, and the manner of its secretion. In this, as in other points of bee-science, his natural shrewdness and acuteness of observation led him to the very verge of some of the most important of those facts in the natural history of bees which we owe to the more scientific researches of Huber. "I have sometimes," says he, "been inclined to think that wax might be an excrescence, exudation, or production from the bodies of the bees, and that, as the Queen can lay eggs when she pleases, so, if need require, the working bees can produce wax from the substance of their own bodies. If this conjecture be right, it will follow, of course, that all the food which the bee takes, contributes to the formation of wax, in the same manner as

all the food which a cow eats contributes to the production of milk, or, to adopt a nearer simile from the insect tribe, as all the food which a spider takes contributes not only to the nourishment of the animal, but to the production of the substance of the cob-web from its body. Numberless other analogies in nature might be adduced in favour of the probability of this theory. The silk, for instance, produced from the body of the silk-worm, is a substance as different from that of the animal itself, or of the mulberry leaf it feeds on, as wax is from that of the body of the bee, or of the honey or flower she sucks. And the excrescence produced in the human ear, which also goes by the name of wax, is certainly a substance as different from that of the body which produces it as either the one or the other. Upon the whole, until I meet with a more probable theory, supported by facts, I must give it as my humble opinion that the wax is produced from the body of the bee alone, or rather, that the bees can speedily convert into wax what they bring from the flowers, and therewith build their combs and seal up both their young and their honey."*

Farina, or Pollen.—Farina, or Pollen, is the fertilizing dust of flowers and forms a very important ingredient in the nourishment of the young bees. Before the discovery of the true origin of wax, it was supposed to constitute the rude material of that substance, being taken into the stomach and converted by some peculiar action of that organ, into real wax; and hence, among French naturalists, it had obtained the name

* Bonner on Bees, p. 195.

of *cire brute,* or crude wax. It consists of an infinite number of small globules, which, in exploding in consequence of the application of moisture, shed a subtle essence over the pistils of the flower, and thus effect the fecundation of the plant. The bees eagerly set about collecting this nutritious substance as soon as the season affords it, and continue to do so throughout the summer, not only for immediate use, but also for storing up against the season when it is not to be obtained abroad. They may be observed upon the anthers of flowers, gathering this substance with unceasing activity, and forming it into little lenticular-shaped pellets which they place in the baskets in their third pair of legs. They often roll their bodies in the flower-cup, and then brush off the pollen adhering to them; and they are sometimes seen tearing in pieces the capsules containing it, in order to get at their object.* The colour varies according to the hue of the flower from which it is collected. In spring it is generally of a bright yellow or orange, as these are the prevailing colours of the early flowers, such as crocuses, snow-drops, turnips, furze, &c. The bee, in each excursion in search of this substance, visits only one species of flower. This is proved by the fact that the little balls, with which they are loaded, are uniformly of one unmixed colour—a wise provision of nature; for thereby is the insect instinctively led to collect, at the same moment, those particles only of farina, which being homogeneous, will form the

* Feburier, Traité des Abeilles.

closest cohesion; and is further prevented from contributing to the multiplication of hybrid plants.*

The collection of pollen by the bees is made in greatest quantity in the earlier part of the day, before the heat of the sun has dried up the moisture which renders it more easily packed into the little masses which adhere to their legs. After they are fully loaded, they return to their hive, and deposit their burden in cells in which there is neither honey nor brood. The mode in which the Bee unloads itself, has been already noticed. Planting her middle and hind legs firmly on the edges of the cell, she sweeps with her fore-legs the pellets from their baskets, and thus drops them into the cell. Another worker instantly inserts her head into this cell, and keeps it there for a minute or two, evidently kneading the farina, and probably mixing with it a portion of honey disgorged from the honey-bag, as it presents a moist appearance on her leaving it. Farina is probably mixed with wax in constructing the combs when the latter substance is scarce, especially in building the royal cells, the *outer* surface of which appears to be nearly altogether farina, and only the *inner* surface of wax highly polished. But the principal use of this substance, after undergoing, perhaps, a peculiar elaboration, is to nourish the brood. This fact was proved by an interesting experiment of Huber. He furnished a hive, with combs containing brood, with honey and water, but no farina, and confined the bees so as to prevent them from seeking this last sub-

* Bevan on the Honey-Bee.

stance abroad. On the third day of their confinement, a loud noise was heard in the interior of the hive, and on examining it, all was found in confusion—the brood was abandoned—the bees ran in disorder over the combs—thousands rushed towards the entrance, and gnawed at its grating. The same symptoms of disorder showed themselves on the two following days, at which time the bees were allowed to escape, and the combs examined. The cells were found all vacant, and the brood had died, doubtless of hunger.

Was the want of farina the cause of this catastrophe? To decide the point, Huber supplied the same hive with fresh brood and abundance of farina, and confined them as before. Next day, they were observed busily employed in consolidating the brood combs that had been given them; and having discovered the farina, they were seen crowding to the cells containing it, extracting a supply, hurriedly mounting the combs, stopping at the cells containing brood, inserting their heads, and remaining in that position a considerable time. On the following day he inspected the combs, and found that all the larvæ had jelly, as in ordinary circumstances; that they had grown in size, and that some had been closed up to undergo their transformation into nymphs. Thus it is placed beyond all doubt that the young bees are nourished chiefly by that fine powdery substance which is found in the anthers of flowers, and is indispensable to their fecundity. Nature, ever wise and provident, has so disposed matters, that the insects which subsist on farina should be able to avail themselves of it

without injury to the fructification of the plants. So far, indeed, from being an obstacle to this, the bees, on the contrary, greatly facilitate it, by applying in their movements the fertilizing farina to the stigma of the flower.

Propolis.—Propolis is a tenacious substance, generally of a dull grey colour, gathered by the bees from the buds of certain trees in early spring; especially from the alder, the poplar, the birch, and the willow. It is of great use to the insect in various ways. The ancients supposed it to consist of three different substances, or rather, perhaps, three different modifications of the same substance, according to the different proportions of wax blended with it, and have been followed in this opinion by some more recent inquirers; yet the generality of intelligent Bee-masters are satisfied that it is in fact a single substance when collected by the bees, and that it is afterwards, when used, mixed by them with common wax in different proportions, according to the purpose for which it is employed. Huber, to ascertain the fact of its origin, stuck some branches of the wild poplar in pots of earth, in front of his apiary. The bees immediately discovered them, and set about loading themselves with the identical substance, which he had often detected adhering to their thighs in the same manner as farina. He observed them "separating the folds of the buds with their teeth, drawing out threads of the viscous substance, and lodging a pellet of it in one of the baskets of their limbs." He ascertained farther, that branches newly cut did not

seem to attract the insect; the viscous matter in them had less consistence, and therefore did not suit its purpose. The branches he used had been cut for some time. This last circumstance seems somewhat unaccountable. It can be but seldom, generally speaking, that the bees have it in their power to gather propolis from *cut* branches; whereas, in point of fact, at the time when they most need that material, we see them busied in hundreds on the *growing trees*, and bringing it home in large quantities.

The bees employ this substance in the commencement of the structure of their combs, to attach them more firmly to the foundation than could be effected by wax alone, which is neither so tenacious, nor attains to so great a degree of hardness. Indeed, it possesses the former of these qualities to such a degree, that the bees find some difficulty in detaching the pellets from the baskets on their legs, and have been observed availing themselves of the aid of their companions for that purpose. And hence, aware of its tenacity, they are observed gathering it only during the heat of the day, when it is rendered more ductile by the warmth. It is employed also in attaching the edges of the combs to the sides of the hive, where it forms a projection from the comb, and serves the purpose of a *point d' appui*. Every Bee-master is familiar with the use made of it in fastening the hives to the floors. It is employed too in stopping all crevices by which the winter's cold might get access; and, above all, it is specially employed as an effective barrier against the intrusion of enemies. The

bees have been observed contracting, by means of propolis, the entrances of their hives, and erecting something resembling barricades with it, when they had reason to apprehend the intrusion of the death's head hawk-moth, a dangerous enemy to the honey-bee, though little known in this country. The name *propolis*,* given to this substance by the ancients, proves that the use the bees make of this resinous exudation in fortifying their dwellings, has been long known. We have one or two amusing instances recorded of a further use which their instinct has taught them to make of this substance. A shell-snail had found its way into one of Reaumur's hives, and fastened itself by its slime to the glass. The bees, unable to remove it, fell upon a most ingenious method, and at a small expense of labour and material, of preventing any annoyance from the intruder. They formed a border of propolis round the edge of the shell, where it rested on the glass, and thus fixed it immoveably. A slug-snail had crawled into a hive of Maraldi's, and was disposed of in a similar manner, though with more violence. The bees immediately surrounded it, and stung it to death. The disposal of the dead body was the next consideration—it was too bulky to be moved by their puny efforts, but they covered it all over with propolis, thus completely preventing the injurious effects that might have arisen from putrifaction.

On the Formation of Swarms.—The swarming

* Propolis, compounded of the Greek words *pro* and *polis*, signifying "before the city."

season is to the amateur in Bee-economy, a most interesting period in the life and operations of these extraordinary insects, and affords, perhaps, fully as much gratification as any other part of their proceedings. By the mere practical Bee-master, who looks almost exclusively to the return of profit arising from their culture, the honey-harvest will, of course, be regarded as the period of most interest. But by the Naturalist, the season of swarming, by bringing into view some of the most striking features of their marvellous instincts, and thus affording additional scope for his favourite studies, will ever be hailed with the most intense delight.

We have already observed that the breeding season commences about the end of January, or early in February, unless the temperature be unusually severe, and continues with constantly increasing progress and activity throughout the summer. The addition thus made to the population is almost incredible. At the beginning of the year, a hive which in the preceding October contained no less than 12,000 or 15,000 inhabitants, will be reduced below as many hundreds; and yet, by the beginning or middle of June, the numbers, provided the Queen be an ordinarily fertile one, and the season not unfavourable, will be augmented to more than the original amount, exclusive of an immense quantity of brood in progress of incubation. It is not surprising, therefore, that about mid-summer, or even before it, there seems a want of room in the hive, and a determination on the part of the bees to desert their crowded habitation, and

to seek for a new one elsewhere. A *crowded population* may not be the *sole cause* of this periodical emigration of the bees; but it seems consonant to the usual course of nature that it should be the *principal cause,* and that others which may be alleged are but subservient to it. No royal brood is reared, unless the population fill the hive almost to overflowing. This takes place sooner or later, according to the size of the domicile ; and hence we find that, generally speaking, small hives swarm sooner than those of larger dimensions.

The heat in a full hive is excessive—the thermometer often rising above 100 degrees,—and may doubtless have its effect in hastening the swarming; and we have oftener than once succeeded in bringing off a swarm, when apparently undetermined, by the artificial application of heat. But this increased temperature is the consequence of the overgrown population in relation to the size of their dwelling. The uneasiness of the Queen is usually stated as one of the causes of swarming, arising from the sight of so many royal cells, each containing, as a sure instinct teaches her, a future rival. However this may hold true in *after-swarms,* it seems at least doubtful whether it be applicable to *the first.* In respect to after-swarms, the then Queen, prompted by jealousy, is desirous to destroy her rivals ; and being prevented by the bees from doing so, she becomes agitated and restless, and finally forsakes a hive where she meets with so much to annoy her. But in the case of a *first swarm,* the Queen-mother meets with nothing but respect and

attention to her wishes from every member of the community. She is their common mother, and is never opposed by them, and might destroy all the embryo-queens without any opposition. And this, in fact, does sometimes take place; for if the weather at this period set in and continue intemperate and stormy, no swarming takes place, for the old Queen destroys the whole of the royal brood. But it is otherwise in ordinary circumstances; and while she is left at perfect liberty to act as she pleases with regard to the unhatched queens, we are led to believe that she is induced to emigrate, not on account of the presence of her embryo rivals, but in obedience to the wise provision of nature for the increase of the species. Whatever may be the real cause, the proceedings of the Queen and the workers at the approach of summer evidently show that matters are ripening for some great internal movement. About the beginning or middle of May, the bees, as if aware of the necessity, begin to form large cells, in which the Queen immediately deposits the eggs of males, and continues to do so for about thirty days. At the same time, some royal cells are formed; for there appears to be a secret relation between the production of the eggs of males and the construction of royal cells; and about the twentieth day of her laying this species of eggs, the Queen, discovering the royal cells, deposits an egg in one of them, and, at intervals of a day between each, in all the other cells of this description. The bees know to close them at the moment when the larvæ are ready to be

transformed into nymphs; and as they in fact close all the royal cells at different periods, it is evident that the inclosed larvæ are not all of an equal age.

The laying of drone eggs having terminated, the Queen, previously large and unwieldy, becomes slender in her figure and more able to fly, and begins to exhibit signs of agitation. She traverses the hive impatiently, abandoning the slow and stately step which was her wont, and in the course of her impetuous progress over the combs, she communicates her agitation to the workers, who crowd around her, mounting on her back, striking her briskly with their antennæ, and evidently sharing in her impatience. A loud confused noise is heard throughout the hive, and hardly any of the workers are observed going abroad to forage; numbers are whirling about in an unsettled manner in front of the hive; and the moment is come, to a considerable portion of the family, for bidding adieu to their ancient abode. All at once the noise in the interior ceases, and the whole of the bees about the doors re-enter; while those returning loaded from the fields, instead of hurrying in as usual, hover on the wing, as if in eager expectation. In a second or two, some workers present themselves again at the door, turn round, re-enter, and return instantaneously in additional numbers, smartly vibrating their wings, as if sounding the march; and at this signal the whole swarm rushes to the entrance in an overwhelming crowd, streaming forth with astonishing rapidity, and filling the air in an instant, like a dark cloud overhanging their

late habitation. There they hover for a moment, reeling backwards and forwards, while some of the body search in the vicinity for a tree or bush which may serve as a rallying-point for the emigrants. To this they repair by degrees, and provided their Queen has alighted there, all, or at least the greater part, crowd around, and form a dense group, sometimes rounded like a ball, sometimes clustered like a bunch of grapes, according to the nature of the resting-place they have fixed on. (Plate VII.) The Queen is not always foremost; it is frequently, or rather generally, not till after the departure of a considerable number of workers that she makes her appearance; and when she does come, it is with a timid irresolute air, as if she were borne along, almost against her will, by the torrent that streams out of the hive,—for she often turns on the threshold, as if about to re-enter, and in fact frequently does so, but cannot long resist the opposing crowd.*

The first swarm is invariably led off by the old Queen. This has been ascertained by actual observation. The Queen leading off a first swarm in one year, has been marked by depriving her of one of her antennæ, and has been found at the head of a first swarm in the year following. This experiment has been so often repeated, and with results so uniform, as to put the fact beyond all doubt. Besides, in examining those hives in which first swarms have been placed, eggs will be found in the cells on the second

* Feburier.

day, which could not have been the case had the leader been a virgin-queen. The reason for the departure of the old Queen with the first swarm is to be found in the fact, that a plurality of queens cannot exist in a hive. Were no swarm to depart, therefore, until a young Queen could put herself at the head of it, this plurality must exist for a time, and the danger arise of a combat between the two sovereigns; and the death of one, at least, and probably of the younger and weaker, would be the consequence. By this means swarming would be prevented altogether.

A swarm, especially a first one, never departs but in fine weather, and at the warmest time of the day. The passing of a cloud over the face of the sun, causing a sudden diminution of the light, is sufficient to stop the emigration for a time, although all is in perfect readiness. The same effect is produced, if, at the moment of rushing out, there is a sudden change of weather; a shower of rain, however slight, or a gust of wind, will restore quiet instantaneously. No sooner, however, does the wind lull, and the sun shine out, though only for a second or two, than all the symptoms of restlessness and agitation are renewed, and the impatient emigrants rush out in myriads.

If suffered to remain any considerable time on the spot where they have alighted in swarming, the bees are apt to rise again, and take a new flight. But their flight now has a different aspect from what it had on first leaving the hive. They do not now hover

round the apiary, wheeling about in mazy circles, and in a kind of regular confusion, but dart away in a condensed body, and with a rapid wing, with a shrill whizzing sound, and almost always in a straight line, as if they had some particular selected spot in view. It is supposed, indeed, and on feasible grounds, that in every case the bees, previous to swarming, have fixed on a place of abode; that they alight in the first instance on a bush or tree, merely as a general rendezvous, before proceeding to their final destination; and that some days previously they send out some of their number in the character of *scouts* to look out for a suitable habitation. Whether this be the fact or not, is a question which has given rise to considerable discussion; and a host of apiarians have taken opposite sides on the subject. The advocates of the *scout system* are Warder, Butler, Bonner, and Knight among the British writers, several French naturalists, and the author of the letters of an American farmer. On the other side are Reaumur, Buffon, Bonnet, and Huber. Who shall decide when such authorities differ in opinion? As far as our experience goes, it is in favour of the scout system. At the approach of the swarming season, we usually place an empty hive or two in the apiary to be ready for the reception of swarms; and few years —perhaps none—have elapsed in which we have not observed for some days before the swarming commences, a few scores of bees very busy in some one of these empty hives;—a circumstance almost uniformly followed by a swarm taking possession of it. They are,

as might be expected, more apt to do so, if the hive contains comb or honey, the smell of which will have its effect in enticing them. But we have had many instances of their fixing on empty hives quite new, and which had never been used. At the same time, we do not mean to say that the bees literally *send* or *commission* some of their number on the duty of selecting a retreat; but we think, that, impelled by instinct, numbers do go on this errand; that each succeeding day they are joined in their search by others of the community; that thus a great proportion of the population may have visited the spot selected; and that, therefore, when the emigration takes place, a large body of the bees naturally betakes itself to the place pitched on, and is followed by the general swarm with the queen. We would not go so far as to maintain, as some have done, that in *all* cases the bees have previously chosen their intended retreat, and that the shrub or bush on which they first alight, is only meant to serve as a rallying point previously to their final flight. Were this always the case, it is not likely they would submit so readily to be intercepted by the bee-master, and remain contentedly, as in ninety-nine cases out of a hundred they do, in the hive in which he has placed them. The truth is, perhaps, that the writers on bees, like writers on many other subjects, especially of Natural History, are fond of classing the acts and proceedings of their favourites under certain fixed and uniform rules, from which they are supposed never to deviate. Whereas daily ex-

perience may convince us, that bees, like human beings, are often the slaves of circumstances, and that their instinct is sometimes at fault.

Second Swarms.—After the departure of the first swarm with the old Queen at its head, the community is, for a time, without a reigning Queen. There is brood in the royal cells, but none come to maturity; and it is not till the fifth, sixth, or seventh day in ordinary cases, that the senior of the young princesses is hatched, and takes her place as Queen regnant. Her first step is to hasten to the other royal cells, and endeavour to destroy her rivals. In these attempts, with which she is incessantly occupied for several days, she is strongly opposed by the workers, to whom, so long as she remains a virgin, she is an object of indifference; and the scene takes place which has been described in page 95. At every repulse by the workers, she utters the shrill monotonous sound which is called *piping*, and which is heard for two or three days previous to the departure of a second swarm; while the younger Queens in confinement respond, sometimes two or three of them at the same moment, in a voice sounding hoarse from the recesses of their prison. Irritated by such opposition, and annoyed at the sight of so many royal cells in every quarter, the young Queen becomes extremely agitated, and at last rushes, together with the bees to whom she has imparted her agitation, through the outlets of the hive, and thus forms the second swarm.

Circumstances sometimes occur to prevent the departure of a second swarm. If the young Queen, as

soon as hatched, sets out in search of the males, and is impregnated, no further emigration will take place, because, being now about to become a mother,—the character to which alone the bees render their homage,—she enters into the full possession of her rights, and is allowed to attack and destroy all the unhatched royal brood. And, further; swarming is equally at an end, when, after the departure of the first colony, the remaining population is too small to keep up a vigilant guard over the royal cells. In that case, as if aware of the impossibility of a second emigration, the bees abandon the watch, and the young Queens, leaving their cells, engage in mutual combat till all are destroyed except one, who reigns undisputed sovereign. But in ordinary circumstances, the agitation of the Queen, abundance of brood, a favourable season, and, perhaps, other causes unknown to us, all lead to farther emigration, and, in populous hives, this may take place *three* and even *four* times. The interval between the first and second swarm is from eight to twelve days; it is of a shorter duration between the second and third, and still less between the third and fourth; in fact, when a fourth does take place, it is always on the day following the departure of the third.*

It may appear surprising that a hive can swarm so often without being too much weakened. The first swarm is frequently so large that the hive seems altogether deserted, yet, in eight or ten days afterwards, the population is in such abundance as to be able to send forth another colony. But we must remember

* Feburier, Traité des Abeilles.

that swarms depart only during the warmest part of the day, when a full third of the workers are busily engaged in the fields; these, returning home, resume their labours, and carry on the necessary operations of the hive. Besides, "the Queen has left an immense quantity of brood of all ages, which is soon hatched, and which renders the population as great after swarming as before. Thus the hive is perfectly capable of affording a second colony without being too much impoverished. The third and fourth swarms weaken it more sensibly, but the inhabitants always remain in sufficient numbers to preserve the course of their labours uninterrupted, and the losses are soon replaced by the great fecundity of the Queen. And, farther, many of those workers who, in the agitation of the moment, had followed the crowd, do not eventually become members of the new colony. When the delirium attendant on swarming seizes on the bees, the whole rush forward, accumulate towards the entrance of the hive, and are heated in such a degree that they perspire copiously; those near the bottom, and which support the weight of the rest, seem perfectly drenched, their wings grow moist, they are incapable of flight and, even when able to escape, they advance no farther than the alighting board of the hive, and soon return; those, too, that have lately left their cells, remain behind the swarm, still feeble, for they could not support themselves in flight; here, therefore, are also many recruits to people what we may have thought a deserted habitation."*

* Huber, p. 165.

When the swarming is over in any particular hive, the new Queen, on the departure or death of the rest, and the restoration of the ordinary tranquillity of the community, goes abroad on the following day, generally the fifth of her existence, to meet the males, and is impregnated. Forty-six hours afterwards, she commences laying the eggs of workers, and continues to do so for the eleven succeeding months. This does not, however, hold strictly true in every case; for it sometimes happens, if the season be favourable, that the swarm led off by the old Queen, produces, in about a month afterwards, a new colony, which is also headed by the same female. Before leaving the old hive, she had terminated her *great laying* of drone eggs, and thus became able to fly from her greater lightness, and to set out to found a new colony. In this she recommences the laying the eggs of workers, and continues to do so for ten or twelve days, after which she deposits a few drone eggs in cells which the bees, as if aware that she would require them, have already prepared for their reception. These male eggs, though few, are enough to encourage the bees to construct royal cells; and if, in these circumstances, the weather be favourable, a swarm may be formed, and the same Queen depart at its head. Nor is this variation in the swarming operations restricted to the instance of the old Queen; we have known two or three instances in which a *young Queen*, that is, a Queen of the current year, after leading off, as in ordinary circumstances, an after-swarm, has again issued with another swarm from her new habitation.

This fact, which, it must be acknowledged, occurs very seldom, is at variance with the doctrine of Huber, that the young Queen lays the eggs of *workers* only for eleven months successively. He admits, though not very explicitly, that a Queen hatched in spring may lay fifty or sixty drone eggs during the course of the ensuing summer, but he refers to the swarm led forth by the *old Queen*, exclusively, when he speaks of its producing a new colony in the same season in the course of a month after its first departure. With respect to the eleven months, it certainly consists with our own experience, that, as Feburier asserts, the time occupied by the Queen in laying the eggs of workers before she begins that of drones, and, of course, those that shall produce Queens and their accompanying swarms, varies according to the temperature, and especially to the abundance of food. A swarm, for example, that came off at the end of June, sometimes throws off a swarm about the middle of the following May, which is little more than ten months of an interval, and, on the other hand, it sometimes happens that a hive which has swarmed at the middle of May, does not throw another till the end of June in the following year, which is above 13 months.

On the Diseases and Enemies of Bees.—Much exaggeration has prevailed amongst apiarians on the subject of the diseases of bees, many of which, or rather most of which, seem, on careful examination, to have no existence but in the imagination of the observers. After long experience and attentive ob-

servation, we are satisfied that this insect is subject only to one malady, namely, dysentery. *Vertigo* has been spoken of by many writers, especially on the continent, as one of their ailments, but, we think, without sufficient grounds. We have occasionally seen bees in that state of dizziness which is ascribed to vertigo, but have invariably found that when seized and held in the hand for a second or two, and again let go, they return to their usual occupation without any marks of disease. *Swelling of the antennæ* is also mentioned as a bee-malady,—we have never seen an instance of it, and, from its being unnoticed even by many of those naturalists who have furnished long lists of the disorders of bees, it seems to have as little foundation in reality as vertigo. In fact, dysentery appears to be the only serious disorder to which these insects are liable, and various causes have been assigned for it, such as their feeding on honey-dew, on the juices of certain fruits, on plants of a poisonous nature, on honey alone without a due mixture of pollen, &c. &c. No evidence from accurate experiment has been adduced in favour of these theories, and, perhaps, their inapplicability is established by the fact that a well peopled hive is never assailed by this disorder, provided its inmates are in the full enjoyment of their liberty. We are led to conclude, therefore, that it proceeds simply from long confinement, by which the necessary evacuations are prevented. It is well known that the bees, when in health, never void their excrement within the hive. When their owners, therefore, from mistaken care,

remove them into a dwelling-house in order to shelter them from the winter's cold, or when a long track of inclement weather confines them within doors, they are obliged to retain their fæces so long that the consequence is an attack of dysentery. Its existence is easily detected; the floor-board and the combs are covered with stains produced by the excrement, of a dark brown colour, and which diffuse through the hive a most offensive smell, and this last circumstance, no doubt, contributes to augment the evil, for the bees and brood, inhaling only an unwholesome air, must be fatally affected.

Enemies of Bees.—The enemies of bees are numerous, though many of them are by no means formidable. Swallows, spiders, ants, frogs, wood-lice, poultry, small birds of almost every kind, are all reckoned amongst their foes, but their ravages are trifling, and seem to have for their object rather the dead bodies than the living insects. During the time of the massacre of the drones, we have often seen blackbirds stealing from among the bushes near the apiary, in the autumnal evenings, and carrying off, one by one, the whole of the carcases of the males that had been destroyed during the day; we have never observed them attacking the living insect. There is a kind of beetle also, (*Clerus Apiarius*, Pl. VIII. fig. 1,) which, according to Aristotle, inhabits bee-hives, and which, while yet in the larva state, feeds on the larvæ of the bees; we have never heard of any instance of such being met with, or injurious to bees in this country. More to be dreaded are *field-mice*, which sometimes

gain access to the interior, and ultimately ruin the hive. But this takes place only in winter, when the bees are languid or partially torpid, and when there is a lack of vigilance on the part of their owner. A still more formidable enemy is the *wax-moth,* (*Tinea Mellonella,* Pl. VIII. fig. 2,) of whose ravages Feburier has given a long and minute detail. This insect is extremely alert in discovering any crevice by which it may penetrate into the hive, and easily effects its purpose if the bees are not numerous, and there is no centinel on the watch. They lay their eggs in the sides of the hive, or in the rubbish on the floor, or even in the combs which are farthest from the entrance. Every egg contains an insect, which, in due time becomes a moth. It appears first under the form of a worm or larva, and it is in this stage that it commits its ravages, extending its galleries or covered ways throughout every quarter of the interior, and devouring, not honey or wax, neither of which substances seems to be its proper food, but the exuviæ of bee nymphs, and, very probably, the nymphs themselves. Certain it is that the population of a hive infested by these destructive creatures, diminishes with such rapidity as leads to the conclusion that they prey upon the brood itself as well as on its exuviæ. The bees give ground step by step, until, being greatly reduced in numbers, they at last utterly abandon the hive. Another moth of a kind dangerous to bees is mentioned by Huber, namely, the *Sphynx Atropos,* or Death's-head Hawk-moth, so called from its having on its thorax a mark somewhat resembling a death's-head (See Pl. IX.)

This insect is of gigantic size, and is endowed with great strength, and it is conjectured by Huber to possess a faculty like that which he supposes to reside in the Queen-bee, of emitting a certain sound which strikes the bees with terror, and thus enables it to extend its ravages with impunity. While in the caterpillar state, it feeds on the leaves of the potato, and makes its appearance in its last and perfect state towards the end of summer. It is described as most injurious to the bees on the continent, and in some parts of Africa; fortunately it is seldom seen in this country.* *Wasps*, particularly those of the hornet species, are most destructive to bees. We have often observed one of these marauders enter a hive with fearless intrepidity, and, watching its motions through the glazed frame, have been astonished by its feats of strength and agility. In ascending the combs it is, of course, instantly attacked by the rightful inhabitants; if one only venture to assail it, the unfortunate bee has no chance of victory, and but little of escaping with life; if five or six cluster round it, as is generally the case, and cling close to its body, endeavouring to pierce it with their stings, their efforts are set at nought by the intrepid wasp, which struggles with unwearied obstinacy, rolls along the floor of the hive so closely enveloped in a mass of bees, that but little of its body is visible, and though at last it is forced by overwhelming numbers to take to flight, it flies off apparently uninjured from the conflict. These

* A more detailed account of it will be found in that volume of the Naturalist's Library which treats of British moths and hawk-moths, p. 133.

partial attacks of single wasps, however, are of little moment, farther than that they are, perhaps, exploratory; it is when they come in a body that the safety of a hive is endangered; in such cases the utmost care of the bee-master is often unavailing. The wily insects soon discover the weakness of any particular hive in point of population, and, acting on this discovery, attack it in such numbers, that nothing but its removal can save it from speedy and utter destruction.

Bad as wasps are, the *Bees* themselves are the worst enemies to their own species. In a backward spring, or toward the end of autumn, when the population begins to be scanty, some bees may be observed lounging about the apiary, as if conscious that there was no present scope for the exercise of honest industry, and, like other idlers, seem ripe for any mischief. A single bee may be seen peering into the entrances of several hives, as if to ascertain the strength of the population, or the vigilance of the guards; and on finding access from a deficiency in either of these particulars, proceeds to carry off its load from the store-cells. After frequently repeating these domiciliary visits, it returns at last with several of its companions, their numbers increasing at every visit, till the hive becomes a scene of pillage and slaughter. Their first endeavours are, it is said, to find out and kill the Queen; and after this catastrophe, the rightful owners seem to lose all interest in their property, and associating at last with the robbers, join in the plunder of their own stores.*

* Old Butler, in his "*Feminine Monarchie*," published at

Cold, generally speaking, is prejudicial to bees. When tempted by a bright sun after a fall of snow,

Oxford in 1634, gives, in his quaint way, an amusing description of a scene of bee-pillage. After particularizing various enemies to the honey-gathering tribe, he proceeds—"But not any one of dese, nor all dese togeder, doo half so muc harm to de Bees, as de Bees. *Apis api, ut homo homini, Lupus.* Dey mak de greatest spoil bot of bees and of hoonnie. Dis robbing is practised all de yeer. In winter, soom wil bee prowling abroad; and soom ar so teevishly disposed, dat all de soommer long, wen abundance of hoonni is every wer to bee had, dey wil yet bee filcing, dowg (though) dey die for it. But in Virgo (August) is de most dangerous time of all: den sal all de stalls in your garden bee tryed of wat mettle dey ar made. De Robbers ar towgt (thought) to bee poor swarms and stoks, wic have not sufficiently provided demselvs for winter. But indeed, suc ar fitter to bee robbed dan to be robbers. Der is no teef to *de rich teef:* wo (who) aldowg (although) hee have enoug, and mor dan enoug; yet, by hook or by crook, hee will have more, dowg de poor starve for it. Wen de teeves, having first made an entri, begin to coom tik, and de true bees perceive demselvs to bee assaulted by many; dey suddenly make an outcrie; and issuing out of deir holds by troops, prepare demselvs to battel. Soom keep de gates; soom flie about; soom run in again, to see wat is doon dere; soom begin to grapple wid de enimi; and dat wit suc a noise and din, as if de drum did sound an all-arm. Besides wic base sound, you sal eftsoons in de heat of de battel, hear a more shril and sharp note, as it were of a flute; as saith Virgil,

——————"Vox
Auditur fractos sonitus imitata tubarum,"

wic, I am out of doubt, is tuned by deir generall commander, encooraging dem to figt for deir Prince, deir lives, and deir goods. Den sal you see de enimies bestur demselves most venturously; soom violently, toorrow de tickest, trusting in at de gates; oders scalling de walls, and tearing dem down. On de oder side, de defendants will behave demselves as brave-

a few have left their comfortable dwelling, they are quickly chilled, and in a very short period are past recovery. But with ordinary precautions, in stopping crevices, and providing a sufficient external covering, a well-peopled and well-provided hive runs no hazard from even the severest winter. Consistently with that wisdom that shines forth in every part of creation, insects that feed upon leaves, flowers, and green succulent plants are generally in a torpid state during the winter, when they cannot procure for themselves subsistence abroad. Bees are in this state, and eat little, while cold weather lasts; but

ly, not giving any rest to de enimi; part encountring wit dem dat ar widout, part wit dem dat have broken in, wome in a wile dey draw out by de heels, soom ded, and soom alive. Likewise, witout, you may see soom slain outrigt wit de trust of de speer; soom so dedly woonded, dat dey are not able to go tree foot from de place; and soom more lightly strooken, presently to lose de use of deir wings, and for a wile to leap up and down, forward and backward, like madd tings; so lote ar dese cooragious warriers to yeeld on eider side until dere bee no remedie. If de true men cannot kil de teeves, yet wil dey hold dem by de legs or by de wings, in hope to have help, dowg (though) dey bee drawn after. Moreover, de young soldiers, wic have scarce been abroad before, you sal see de elder sort go round about dem, smooding (smoothing) and trimming dem in every place, as if dey did address and hearten dem to figt. De battel being ended, by repuls of de enimi, dose corpses wic de wasps have left—for, like vulturs, de wasps during de battel prey upon de ded carkases—dey honestly buri as far from de hives as dey can bere dem. And den dey draw togeder at de citti-gates, and dere dey buz one to anoder, as if in deir language dey did talk of de figt, and commend one and oder for deir fortitude."

they are by no means in so complete a state of torpidity as to eat none at all. On a mild day in winter, when the sun shines and the wind is low, we often observe them eagerly taking advantage of this favourable temperature, and coming abroad in hundreds to enjoy themselves in the open air. If we open a leaf-hive in the very depth of the cold season, we shall find them closely clustered together, but in near contact with the provision-cells; and the whole mass moving without separating, and by this means doubtless contributing to preserve the general warmth.

It has been made a question among Bee-writers, whether a mild or a severe winter be most favourable to the health and well-being of these insects? Bonner and others are advocates for mild winters; while White, Bevan, &c., maintain that severe winters are most salutary. We are of opinion that the question admits not of a *general* determination, but that *special* regard must be had to the state of the hives—a circumstance which has been too little taken into account in the discussion. In a well-found hive, it is of very little importance to the inhabitants of what nature the winter may be. If it is severe, they have enough of internal heat to preserve them from the severity of the external atmosphere. Huber found that when the thermometer in the open air stood several degrees below the freezing point, it rose, when plunged into a populous hive, to 86 and 88 degrees. Swammerdam observes that the heat of a hive is such, even in the middle of winter, that the honey never

crystallizes, unless the hive be very weakly peopled. Reaumur found brood of all ages in the month of January; and the same thing was experienced by Huber, when the thermometer within the hive stood at 93°. If, on the other hand, the winter be mild, the bees consume food partially, and frequently go abroad into the open air; and by thus voiding their excrement preserve themselves in health. But the case is far otherwise with a hive thin in population, and scantily provisioned. In severe weather, their numbers are too few to keep up the vital warmth, and they are in imminent danger of perishing, should the cold continue for a lengthened period. Should the winter be mild, they consume their stores; and on the arrival of spring, if they still survive, they run the hazard of perishing of hunger. We are decidedly of opinion, therefore, that the temperature of the winter has much less influence on the prosperity of the apiary, than is generally imagined; and that the bees coming safely through that inclement season, depends in almost every case on the abundance of population and of food. There may be one exception to these general remarks:—In a mild winter, a hive which is thinly peopled, but well-stored with food, has a chance of escaping. But even in this case, we cannot always count on its well-doing, though its failure may arise from a different cause. Want of numbers is injurious, not only because it is accompanied with the want of the requisite warmth, but also because it seems greatly to dispirit the bees; and we have seen many instances of hives deserted

in spring while sufficiently provided with honey, but disheartened by paucity of numbers. Nevertheless, *famine* is one of the worst enemies they have to encounter; and many hives that are supposed to die of cold, do in fact die of hunger.

It will be obvious to the reader, that, in our enumeration of the enemies of bees, we have referred exclusively to those which infest the *European* hive-bee. The various tribes of honey-gathering insects found in tropical regions, have to encounter foes of a still more formidable kind; and, in treating of foreign bees, we shall have occasion to point out enemies, both amongst the feathered race and amongst quadrupeds, whose ravages far exceed any injuries sustained by our domesticated bee.

Practical Management.—*The Apiary.*—In the practical management of bees, the formation and due arrangement of the apiary is of some importance. The prime requisites are *shelter* from the extremes of heat, and cold, and *quiet*. Facing southwards, the hives should be carefully screened from the north and north-east. A group of young trees, or a close-growing hedge, will answer the purpose well; or advantage may be taken of a range of buildings, or a garden wall. In availing ourselves, however, of the shelter of buildings, care must be taken to keep the hives at such a distance as to be clear of the rain-drops, and from the eddying winds caused by such a locality. A distance of not less than eight or ten feet should intervene between them and the screen; and of this space the half-breadth next the hives should be laid

with fine gravel, to absorb the moisture, and keep it free from weeds, grass, straws, &c. The space of ground between and in front of the hives, to the extent of at least three feet, should be covered in the same manner.

Quiet is essentially necessary to their doing well. Bees do not thrive in the near neighbourhood of incessant noise. The apiary, therefore, should be at a distance from smithies, mills, steam-engines, &c., and also from such manufactories as emit noisome smells. When circumstances will admit of it, the apiary should be placed in view from the windows of the family sitting-room. This will save much of the trouble incurred in watching at swarming time, as well as give greater security from marauders. The hives should be elevated about fifteen inches from the ground, on a *single post* or pedestal, in preference to three or four, which is the usual number. Vermin are thus prevented by the projecting edge of the floor-board from climbing over and reaching the entrance. It may be laid down as a good rule to have the hives placed as far from one another as the extent of the apiary will admit. When standing at intervals of only two or three feet, the bees are very apt to quarrel amongst themselves. They sometimes mistake their own proper domiciles when too much crowded together, especially when hurrying homewards in the working season, or hastening to escape a shower, and the mistake is attended with fatal consequences. In feeding a weak hive, a close neighbourhood is particularly dangerous; the smell of the syrup is quickly

diffused over the whole colony, and pillage generally ensues. In swarming, too, when the newly departed emigrants are discouraged by a sudden blast or change of atmosphere, and the Queen hastens to return to her old abode, her ignorance of the locality, having, if a young queen, never been abroad before, renders her very apt to mistake and enter a hive where she is by no means welcome, and, the swarm following her, a bloody conflict takes place. All these inconveniences point out the propriety of a large interval between the hives, and this arrangement is especially called for when, as in very extensive apiaries, the hives are placed in double rows. We do not approve of double rows; they occasion great confusion often in the swarming season. If the number of hives be too large for a single row, let there be a second group formed in another quarter of the grounds. This detached apiary will be found useful in such operations as require the temporary removal of stock-hives from their original stations.

Some difference of opinion exists among Bee-masters as to the precise exposure which the apiary ought to have. In fact, this must be regulated by the nature of the climate; and it is obvious that the hives ought not to face the direction of the prevailing winds, or the rainy quarter. But, generally speaking, a southerly aspect is preferable, inclining, perhaps, a point or two to the east. This is Feburier's opinion, and we think him right. If the bees are induced, in consequence of this easterly inclination, to venture out in the chill of the morning, they have the advantage

of the increasing warmth of the day; whereas, a western exposure tempts them to continue their excursion, and linger in the fields till they are caught by the evening cold.

When the apiary is situated in a garden, there will be no want of bushes and low-growing shrubs on which the bees may alight when swarming. But when it is located on a lawn or smooth level, the swarm is extremely apt to fly off altogether, or to take up its station on some high tree in the vicinity, from which it is difficult to dislodge it. A few ever-green shrubs growing in front of the hives, and at a few yards' distance, will prevent this. Or if such an arrangement be, from particular circumstances, not expedient, the evil may be so far remedied by sticking into the ground, near the apiary, some branches of trees, retaining their foliage, about the period when swarming may be expected. *Water* is essential to the operations of these insects during spring and summer; a shallow pebbly stream in the vicinity will, therefore, be most advantageous, where they can drink without danger of drowning. Its absence should be supplied by artificial means; and a shallow vessel of water placed in a secluded and quiet quarter of the apiary, having a few smooth round stones thrown into it, of a size to project above the surface, and afford footing to the drinkers, will answer the end. The neighbourhood of large sheets of water, however, or of broad rivers, is injurious; the little foragers, in crossing during high winds or dashing rains, perish by hundreds in a single day.

Covered apiaries, or bee-houses, are common in England, and are sometimes, though rarely, met with in Scotland; they have their advantages, but are not without serious drawbacks. They afford shelter from the extremes of heat and cold, and, when properly constructed, are also a complete protection from thieves. But when the number of hives is great, the expense of such structures is so considerable as to preclude entirely their being brought into common use. Besides, their confined limits render it necessary to place the hives quite close to one another—an arrangement which we have already noticed as a great evil. And, finally, in operating experimentally on any particular hive, the whole colony is apt to take the alarm, and to cause a degree of confusion most inconvenient to the operator. There are covered apiaries sometimes to be met with, the superior construction of which precludes these evils; but a much greater number have fallen under our observation where the cheapness of the erection has interfered materially with their completeness and utility. The disadvantages above specified may all be avoided in open apiaries; while in these last, also, all the advantages for which the former are preferred, are, we are persuaded, perfectly attainable. A good thick coat of oat or rye-straw, if the hives be of that material; or, if of timber, a well-seasoned and painted surtout of fir-plank, three-fourths of an inch in thickness, resting on the floor-board, and having a vacant space of an inch between it and the hive, will be quite sufficient security against the extremes of heat and cold.

Protection from thieves has been sought for in various contrivances, certainly not all of them effectual. Feburier cites Lombard's method of security, which consists in fastening a chain to one of the four supports of the floor-board, bringing it over the top of the hive, turning it once round, then taking it down on the opposite side, and fixing it with a padlock to another of the supports. Huish has improved upon this, placing an iron hoop round the body of the hive, having another fastened to it at right angles, and brought over the top, and both attached to a chain, the two ends of which are secured by a padlock to the post which supports the hive. (See Pl. XX. fig. 5.) The security afforded by either of these methods is about as effectual as that which is afforded by "a lock upon leather"—to use an expression proverbial in Scotland; for a thief would hardly be deterred by the complicated apparatus of chains and hoops, or take the trouble of unwinding them, when in a minute's space, he could either pick the lock, or with a saw cut through the three-inch post, and carry off the whole concern. Howatson's mode is better. "The support of the hive is of malleable iron, having a single stem below, but parted into three, or rather four, branches above, on the top of which branches the board of the hive rests. The lower part of the stem is fastened with lead into a large shapeless stone, sunk to a level with the surface of the ground." To this stem is fastened an apparatus of chains and hoops, similar to that of Lombard and Huish.

Of course it is highly in favour of the bees when the

apiary is situated in a country abounding with such natural productions as the industrious insect can turn to account. Large heaths, sheltered with woods, are extremely productive of honey, as the wild thyme and other flowering plants with which they abound, are not cut down by the scythe ; and the heath itself remains in bloom till late in the season. The plane-tree, the whole willow tribe, the furze or whin, the broom, especially the Spanish kind, furnish a rich store both of honey and farina. The bees do not feed indiscriminately on every species of flowers ; several of the most splendid and odoriferous are wholly neglected by them, while they select others, the flowers of which are extremely small, and not apparently possessed of any very valuable qualities. Moreover, they give a decided preference to those spots where a *great quantity* of their favourite flowers grow together. On the continent, fields of buck-wheat afford a copious supply, though the honey extracted from it is of a coarser kind ; and in our own country, the white clover (Trifolium repens), will, in fine weather, be found thronged with them, while scattered plants that afford more honey are neglected. When a variety of bee-flowers flourish in the same field, it is said they will first collect from those which furnish the best honey ; if, for example, several species of thyme grow together, they prefer the lemon thyme, which is of a richer fragrance.

The Bee-master will do well to supply his favourites with such flowers, &c. as are not found growing spontaneously in his neighbourhood. In

addition to the gooseberry, currant, and raspberry bushes, and the several orchard trees, the flower-borders in his garden should be well stocked with snow-drops, crocuses, wall-flower, and, above all, with mignonette, which affords honey of the richest flavour, and which continues flowering till the near approach of winter. The rich melliferous blossoms of the *Buddlea globosa,* too, the bees are very fond of; and some of the Cacalia tribe afford an ample store. "The *Cacalia suaveolens,*" says Darwin, "produces so much honey, that on some days it may be smelt at a great distance from the plant. I remember once counting on one of these plants, besides bees of various kinds without number, above 200 painted butterflies, which gave it the beautiful appearance of being covered with additional flowers."* Besides these, the plants of Borage, (Borago,) and viper's Bugloss, (Echium vulgare) yield a very considerable quantity of the rich liquid. The former is eagerly resorted to by the Bees; it is an annual, and blossoms during the whole season till destroyed by frost. In cold and showery weather, the Bees feed on it in preference to every other plant, owing to its flowers being pendulous. The Bugloss appears as a troublesome weed among corn, and grows on dry soils in great profusion; it is a biennial plant. Turnips, particularly the early garden kind, should be sown and allowed to remain in their beds during the winter; and they will in consequence, by their early flowering, afford a season-

* Economy of Vegetation, Canto IV.

able supply of farina, and also a small portion of honey early in spring. The whole cabbage-tribe also may be made to contribute their share; and mustard-seed, when sown in successive crops, will continue blossoming for many weeks.

We cannot conclude these observations on the situation of the Apiary, without reminding the classical reader of the admirable directions on the same subject by Virgil. In fact, there is not a precept given by the Roman Poet on the practical treatment of Bees, particularly as respects the situation of the Apiary, which is not found at this day, and after the experience of so many centuries, to be the result of an accurate knowledge of the habits of these insects, and highly conducive to their prosperity. While we smile at the fable of Aristæus, and plume ourselves on our more correct understanding of their natural history, the most skilful Apiarian among us will do well to listen to his practical directions.

Principio, sedes apibus, statioque petenda
Quo neque sit ventis aditus (nam pabula venti
Ferre domum prohibent) * * * *
Absint et picti squalentia terga lacerti
Pinguibus a stabulis, meropesque, aliæque volucres;
* * * * * * *
Neu propius tectis Taxum sine; * * *
altæ neu crede paludi,
Aut ubi odor cœni gravis; * * * *
At liquidi fontes, et stagna viventia musco
Adsint, et tenuis fugiens per gramina rivus;
Palmaque vestibulum, aut ingens oleaster inumbret;
Obviaque hospitiis teneat frondentibus arbos.
In medium, seu stabit iners, seu profluet humor,

Transversas salices, et grandia conjice saxa:
Pontibus ut crebris possint consistere, et alas
Pandere ad æstivum solem; si forte morantes
Sparserit, aut præceps Neptuno immerserit Eurus.
Hæc circum casiæ virides, et olentia latè
Serpylla et graviter spirantis copia thymbrae
Floreat: irriguumque bibant violaria fontem.

Georg. iv.

Hives are found of almost all shapes and sizes, and of various materials—circumstances influenced sometimes by convenience, but oftener by the taste and fancy of the owners. In France, particularly, where the culture of the Bee has been much attended to, the variety of hives is very great; but with few exceptions, they appear to be remarkably deficient in simplicity. This is an important point to be attended to, both as regards the accommodation of the bees, and the convenience of the Bee-master. As far as respects the mere collection and storing of the honey, the kind of hive is but of secondary importance. If the season be propitious, and the country rich in flowers, the industrious collectors will cheerfully deposit the fruit of their labours in any moderate-sized receptacle that appears to afford security and shelter. It is the interest of the owner, however, to ascertain what material and construction will answer best for sustaining an equable temperature during the heats of summer, and most effectually secure the comfort of the inmates during the severity of winter. And, besides these indispensable requisites, there are other considerations to be attended to in the structure of hives which, to the Naturalist and Amateur, are

matters of no little moment. It would far exceed our prescribed limits to attempt a description of the multitude of hives that the ingenuity of one class of Bee-masters has invented, and another has improved upon. We shall, therefore, notice those only that are in general use, and those which, from their great utility, deserve to be better known.

Straw Hives, of the common bell-shape, with all their imperfections, will continue in use, because they are easily made and cost little—because the handling of them requires little skill—and because, as long as the suffocating system is persisted in, they answer the purpose well enough. It would be desirable, however, that more pains were bestowed on their form. To concentrate the heat—to retain it, and thus to accelerate the hatching of the brood, on which so much depends, no shape in our opinion is so well adapted as the globular. We would therefore recommend straw-hives to be made in the form of a globe, having the third of its diameter cut away. (See Pl. XX. fig. 1.) Perhaps, the cycloidal shape would answer nearly as well, and would be probably more easily made. (Fig. 2.) In either of these forms, one rod of three-fourths of an inch thickness, forced through the hive at right angles to a line drawn from the entrance, and about an inch higher up than the centre, would be sufficient to support the combs, because the mouth of the hive being of less diameter than the centre, the combs, from their wedge-like shape at the lower extremity, would not be so apt to sink down by their own weight. We may mention

as our reason for the above recommendation, that we have uniformly found that such of our straw-hives as approached nearest the shape recommended, have been, *ceteris paribus*, the first to swarm, and have swarmed the oftenest. We had till lately in our possession, one of the form fig. 2, which had for three successive years thrown each year three swarms.

Wildman's Storied Straw Hive.—This is preferred by many to wooden hives on the same plan, from the persuasion that straw is a preferable material. It consists of two or more stories, each seven inches in height, and ten inches in diameter. In the upper row of straw, there is a hoop of about half an inch in breadth, to which are fastened six or seven wooden spars, each one-fourth of an inch thick, and one and a quarter of an inch broad, and half an inch apart from each other. To these bars the bees fix their combs. In order to give greater steadiness to the combs, and prevent their being broken or deranged when the hive is moved, a rod is run through the middle of it, in a direction across the bars, or at right angles with them. A flat cover of straw, worked of the same thickness as the hives, and twelve inches in diameter, is applied to the uppermost story, " made fast to the hive with a packing-needle and thread," and carefully luted. Before it is put on, a piece of clean paper, of the size of the top of the hive, should be laid over the bars, the design of which is to prevent the bees from working in the intervening spaces. (Pl. XIII. fig. 3.)

Grecian Hive.—This has long been in use in the

Greek Islands, and is sometimes called the Candiote Hive. It is in the form of a flower-pot, open at the top, and provided with a flat cover in the same manner as the hive last described. As in this last, also, a certain number of bars are fastened to the uppermost roll of straw, each designed for the foundation of a comb; and when prepared for use, the cover is laid above these bars, fixed at the edges by wooden pins, or sewed with pack-thread, and having the joining carefully plastered with clay. (See Plate X., fig. 4.) This hive affords considerable facilities for forcing the bees to work in wax. It is only necessary to remove one or two of the combs, and the bees will immediately commence filling up the vacancies. In this way, a portion of their honied stores may be abstracted without difficulty, and without having recourse to the barbarous practice of suffocation. It affords also the means of making artificial swarms. It will be observed that in consequence of the diameter of the hive gradually diminishing towards the bottom, rods inserted through the body of the hive are rendered unnecessary, the wedge-like form of the combs serving sufficiently to support them. "The hives," says Wheeler in his *Journey into Greece*, "are made of willows or osiers, fashioned like our common dust-baskets, wide at top, and narrow at the bottom, and plastered with clay or loam within and without. The tops are covered with broad flat sticks, which are also plastered over with clay; and, to secure them from the weather, they cover them with a tuft of straw as we do. Along

each of these sticks, the bees fasten their combs ; so that a comb may be taken out whole, and with the greatest ease imaginable. To increase them in spring-time, (that is, to make artificial swarms,) they divide them, first, separating the sticks on which the combs and bees are fastened from one another with a knife ; so taking out the first comb and bees together on each side, they put them into another basket in the same order as they were taken out, until they have equally divided them. After this, when they are both again accommodated with sticks and plaster, they set the new basket in place of the old one, and the old one in some new place. And all this they do in the middle of the day, at such time as the greatest part of the bees are abroad ; who, at their coming home, without much difficulty, by this means divide themselves equally. In August, they take their honey, which they do in the day time also, the bees being thereby, say they, disturbed the least ; beginning at the outside, and so taking away, until they have left only such a quantity of combs in the middle as they judge will be sufficient to maintain the bees in winter ; sweeping those bees that are on the combs into the basket again, and covering them anew with sticks and plaster." Huish has adopted this hive with some additional apparatus. (See Plate X., fig. 5.) The cover, instead of being flat, as in the original hive, has considerable convexity, in order to facilitate the flowing of the water, produced by the condensed vapour, towards the circumference, instead of its being allowed to drop on the bees. To prevent them

from working in the spaces between the bars, and thus presenting an obstacle to their easy removal, he spreads over them a piece of gauze or net-work, satisfied that the bees will not construct their edifices on so flimsy a foundation. Over the net-work he places a flat round board, divided into several sections, each of which is moveable on hinges, and may be opened in one or more divisions, as it may be desired to remove one or more combs. In this circular cover are several air-holes, closed with tin gratings, to allow the heated air to escape.

Lombard's Hive.—The only other straw-hive worthy of notice, known to us, is that of M. Lombard of Paris, the friend and correspondent of Huber, and author of a work on bees, which that distinguished naturalist highly commends. This hive is in some degree a storied one, and differs from others of that kind only in having its upper story less than half the capacity of the lower or body of the hive; and that, at the honey-harvest, the contents only of the former, which its inventor calls the Couvercle or Cap, are appropriated by the cultivator, while those of the latter continue from year to year the exclusive property of the bees themselves. Plate X., fig. 6, copied and reduced from Lombard's Work, gives a sketch of this hive, where *a* is the cap, surmounted by a pointed piece of wood, designed for the firmer fixing of the straw covering; *b* is the body of the hive, having a thin square piece of deal fixed at the top as the foundation of the combs, leaving open spaces at each side for the passage of the bees; *c, c,*

are two small rods which, on the top being brought close down on the body *b*, serve, by being fastened together, to keep the former steadily in its place. This hive possesses no superiority over the common storied ones, of which it is a modification; and the plan of retaining the same combs in the body of the hive for a series of years, must prove decidedly injurious to the prosperity of the colony.

Of the straw hives here described, we give a decided preference to that of Wildman, both in respect to material and construction, maintaining, as it does, a constant equability of temperature, and enabling the operator to practise the mode of partial deprivation, which will be afterwards described. We think, however, the dimensions may be enlarged with advantage, and would recommend the diameter to be 12 inches instead of 10, and the height of each story to be $7\frac{1}{2}$ inches instead of 7. This will bring the hive, when consisting of two stories, to the capacity of a solid foot. It will be of advantage, also, to have the upper and lower bands of each story worked double, the one exterior to the other, as represented in Plate X., fig. 3. This will contribute greatly to the steadiness of the hive, and afford the means of connecting the stories firmly together by pack-thread or wooden pins.

Bee-Boxes.—The respective merits of *straw-hives* and *bee-boxes* have often been made the subject of discussion. Certainly those of straw have a decided superiority over those of wood, in respect to their capability of maintaining an equable temperature,

from the non-conducting quality of the material of which the former are constructed. The latter are more easily kept clean—they furnish better means of defence against vermin—they are a great deal more durable, and afford a much greater facility for operating experimentally, and studying the nature of their interesting inmates. And what is always of importance in matters of rural economy, their cost, at least as regards the simpler kinds, is very little more than that of the straw hives; and if we take their durability into account, it is actually less. But the nature of the material of which they are made, rendering them easily affected by variations of the external temperature, furnishes an important and well-founded objection; for notwithstanding all the precautions used, no practicable or manageable thickness of material, nor wrappings of straw ropes and straw covers have been found effectual in remedying this defect. We are of opinion, therefore, that those who cultivate bees for the sake of their produce only, and who have no particular desire to study minutely their natural history, or to witness their proceedings in the interior of their dwellings, will do well to adhere to hives of straw; and of these, by far the best in our estimation, is the storied straw hive of Wildman, already described.

There is a greater variety of form and structure in the wooden hives, than in those of straw; but the storied kinds, of various dimensions, are most generally used. Wildman has invented one of this kind, for a long and somewhat unintelligible description of

which we must refer our readers to his treatise. It appears to be a very complex structure, and therefore so far ineligible; for every bee-master, in operating with his little irritable and impatient labourers, feels as very serious obstacles to his success, the machinery of drawers, dividers, sliders, grooves, &c. This form of the storied hive, accordingly, has never been brought into general use. A simpler construction has become popular. Ten years after Wildman's work was published, Mr. Keys published his Treatise, in which he gives his plan of a storied hive, the chief improvement of which consisted in the employment of the cross bars of the Grecian hive, and arranged nearly in the same manner, instead of the complex and cumbrous sliding frames of Wildman's. Seven years ago, Mr. Howatson, in a useful little manual on bees, advocated a story-hive, in the construction of which he professes having endeavoured to combine the advantages of both Wildman's and that of Keys, while he aimed at greater simplicity, and a diminution of expense. We think he has succeeded in his views, and his success would be still more complete were the troublesome, and, in our opinion, unnecessary apparatus of "glass slips" dispensed with. "The boxes (Pl. XI. fig. 1.) are made of fir-deal,* $\frac{3}{4}$ of an inch thick;" a full inch in thickness, and even a little more, would be an improvement,—there would be less chance of the internal heat escaping, or of the external cold penetrating.

* Poplar, in the opinion of T. A. Knight, Esq., would answer better, from its looser grain, and consequent non-conducting quality.

"The inside dimensions of each are 12 inches by 9, and 8 deep; the whole depth of the skep (hive) is therefore 16 inches, and its capacity one solid foot. Each box has 8 wooden spars, 1 inch broad, and $\frac{3}{8}$ thick, as a foundation to the combs. The length of the upper side of each spar is $9\frac{1}{2}$ inches, while the under side is only 9, *a half-check*, as tradesmen say, of $\frac{1}{4}$ inch being made in the under side at each end. But the upper side of the spars must be flush with the upper edge of the boxes; wherefore a check must be made to receive the spars in the long sides of the boxes also. The intervals between the spars in the upper box are closed with slips of glass, the ends of which rest on the same check as the spars. In the under box all the intervals are left open, not only that the bees may have a ready passage up and down, but also that the whole interior air may be of the same temperature."

In Dr. Bevan's "Honey-Bee" we have the description of another storied hive (Pl. XI. fig. 2,) which differs from the last described only in dimensions, and in the number of bars; the size of the former being 12 inches square, and 9 deep, inside measure; and the bars six in number, and $1\frac{1}{2}$ inch broad. We have reason to know, however, that since the publication of his excellent Treatise, Dr. B. has found reason for making some alteration in his hive, and that he now recommends the dimensions to be 12 inches between back and front at the top, but gradually tapering inwards to $10\frac{5}{8}$ inches at the bottom, with the view of supporting more firmly the weight of the

combs, which will thus have the form of a wedge, and 11⅝ inches between end and end; the bars to be 1⅛ inch in breadth, 7 in number, and to measure from the centre of one to the centre of another 1⅝ inch.* He has also, on the suggestion of Mr. Golding, an intelligent Kentish apiarian, adopted another improvement. To induce the bees to lay the foundation of their combs on the centre, and in the direction of the bars, instead of across the interstices, as they often do, thus preventing their easy removal when desired, Wildman spread over them a sheet of paper. Huish uses a covering of gauze, and Howatson inserts slips of glass; the two former from a belief that the builders would not erect their structure on so unstable a foundation as paper or gauze; and the latter, from a knowledge of their dislike to the smooth and slippery surface of glass. Dr. B.'s method, recommended by his friend, is preferable to them all; it consists in fixing to the under side of each bar a small piece of comb, and thus furnishing the bees with a line of direction which they will implicitly follow. The expedient of a guide-comb has been long known and practised, but the mode of attaching it to the bar adopted by Dr. B. is simple and ingenious. He pours a little melted wax on the under surface of the bar, and, while it is warm and in a liquid state, applies to it longitudinally a piece of guide-comb, taking care that the centre of the comb, formed by the bottoms of the cells, shall ex-

* The back and front boards, in consequence of the slope, measure in thickness one inch at the top, and rather more than one inch and six-eighths at the bottom.

actly correspond with the centre of the bar; when the wax hardens, which it does in a few seconds, the comb is firmly fixed. To save trouble, every *second* bar only need be furnished with this guide.*

The storied hive appears to us simple and convenient; and it has this very decided advantage, that the use of it, as will be illustrated when treating of the honey-harvest, renders perfectly and completely practicable the preservation of the life of the bees, and that, too, without any difficulty or nicety of operation that might scare the timid cultivator from the humane attempt. The storied hive affords, also, great facilities for uniting, at the end of the season, two weakly swarms, or two weakly provided hives. By means of smoke blown in at the door below of the two hives to be united, the bees are forced into the upper boxes, which are then separated and placed one above the other, thus forming a stock strong both in population and provisions, and securing, in all probability, early swarming in the following season. Terrified by the smoke, the bees readily unite without bloodshed.

Huber's Hive.—The hive invented by the celebrated Huber, and which he has called the book or leaf-hive, possesses, in our estimation, more valuable properties, taken as a whole, than any other we are acquainted with. It has all the advantages of a com-

* Since the above was written, Dr. Bevan has published a Second Edition of his excellent work, where, in pages 82 and 93, he gives detailed descriptions of the size and arrangements of his Bee-Boxes.

mon bee-box, as to capacity, cleanliness, and security against vermin, while, at the same time, it enables the cultivator to ascertain at all times the state of his colony, nay, of every individual comb, the progress of the brood, the quantity of provision, the existence and number of royal cells, and the probable period of swarming. It affords every facility, too, for making artificial swarms, and for discovering the exact period when that operation may be attempted with a reasonable prospect of success. The greatest drawback is its expense,* which is such as as to preclude any but amateurs from having recourse to it. A figure of this hive, as used by Huber himself, is to be found in his "Observations on Bees;" another of the same hive, as afterwards modified by him, has been given by M. Lombard, (Plate XI., fig. 3.)

The leaf-hive consists of eight frames, each 18 inches high,† English measure, and ten inches wide, inside, having the uprights and top cross pieces $1\frac{1}{2}$ inch broad and one inch thick, so that the eight frames, when placed close together, constitute a hive, eighteen inches high, twelve inches between end and end, and ten inches between back and front, all inside measure. The frames are held together by a flat sliding bar on each side, secured by wedges and pins. To the first and eighth of these frames is attached a frame with glass, and covered with a shutter. The body of the hive is protected by a sloping roof, and

* One Guinea is the usual price.

† Fourteen or fifteen inches at most would be a better size for the uprights.

the entrance is made through the thickness of the floor-board. We dislike the sliding bars, with their pins and wedges, which are so far inconvenient, that, in drawing them out, all the frames are liable to open, and the observer is exposed to some hazard of annoyance from the bees issuing out at every joint; and we have substituted for them hinges on the one side, and a hook and eye on each frame on the other; we can thus open any particular leaf without meddling with the rest. In taking honey from this hive, the bee-master has the whole interior completely under his eye and at his disposal, and can choose what combs best suit his purpose, both as to quantity and quality; taking care, however, to do so only at such periods as will leave the bees time to replenish the vacancy before the termination of the honey season. It is also well adapted for artificial swarming. By separating the hive into two halves, the honey, brood-combs, and bees will, generally speaking, be equally divided; and by supplying each half with four empty frames, we shall have two hives, one half empty, equal in number of bees, of brood, and even of stores. One of the new hives will possess the Queen; and if the operation has been performed at the proper time, that is to say, a week or ten days before the period of natural swarming, the probability is there will be royal brood coming forward in the other; at all events, there will be plenty of eggs and larvæ of the proper age for forming an artificial Queen.

Single-comb Hive.—The celebrated naturalist, Bonnet, suggested and recommended to Huber the adop-

tion of a hive which should admit of only one comb, and that indefatigable apiarian soon succeeded in constructing one, the sides of which, composed of glass, were separated by so small an interval, that only a single comb could be erected between them. In this he found no difficulty in establishing a swarm; the bees pursued their labours with the same assiduity and regularity as in other hives, and, every cell being exposed to view, none of their proceedings could be concealed. Huber has not given any directions as to the dimensions or the mode of constructing this hive, but they have been supplied by Feburier, though he does not name the inventor. "It consists of a frame from $1\frac{1}{2}$ foot to 2 feet in height, and from 1 foot to $1\frac{1}{2}$ foot in breadth. The uprights and cross-bar at the top, are about 2 inches thick, and $1\frac{1}{2}$ inch broad. This breadth being sufficient to admit of the bees constructing a comb, forms almost the whole interior of the hive. To this frame is applied on each side another frame of the same dimensions, except that it need not be above $\frac{1}{2}$ inch in thickness. In each of these outer frames is placed a pane or panes of glass, in such a manner, that the distance between, constituting the width of the hive from back to front, shall be 20 lines, that is 12 for the thickness of the comb, and 4 on each side for the passage of the bees. These dimensions must be correctly observed; at least, the width had better be diminished than augmented, otherwise the bees will work against the glass. The frames are attached to one another by hinges on the one side, and hooks on the other,

or by iron wire. An entrance is made by cutting, in the middle of the lower quarter of the frame, a notch sloping upwards from the outside. There must be an entrance both before and behind, the doors of which are opened and shut at pleasure. This hive must be covered with a wooden surtout resting on the floor-board. To save the trouble of lifting it off every time we observe the bees, an opening is made in each side with a shutter fitted to it, of the same size with the glass; and as it is necessary that the bees should be kept from getting between the hive and the surtout, there must be a covered passage leading to the outside. This hive presents great facilities for making experiments, and for observing the proceedings of the bees, which being prevented from constructing more than one comb, cannot conceal any part of their operations as in other hives. They soon become accustomed to the removal of the surtout, and are not at all disturbed by our observing them. The Queen may be followed in all her movements, and even in her laying. It is easy to lay hold of her at any time, either in the hive or in the passage. The bees may be fed and retained prisoners; they may be forced to make wax from honey, honey from sugar, &c. In short, all the experiments that have ever been made, may be verified by means of this hive, the result found, and new experiments tried. In spite of its peculiar advantages, however, it has inconveniences which annoy the Naturalist. It is very difficult to introduce a swarm into it, how much soever the operator may

have been accustomed to manage bees. The insects cannot cluster together in it, as in other hives, and concentrate the heat during winter, and, therefore, are liable to perish; and the smallest variation of the atmosphere is injurious to the brood. If, in order to preserve it, it is put into a warm place, it must be constantly fed."

This is the kind of hive we have made use of in our experiments; and as the figure, given by Feburier, (Plate XII., fig. 3,) is but little adapted to convey a correct idea of it, we shall present our readers with a sketch of our own hive, exhibiting what we consider some improvements on the original. Fig. 2, Plate XII., is the frame which contains the comb, two feet long and eighteen inches high, inside measure. The uprights A and B, and the top piece C, are two inches broad, and one inch thick; *f*, *f*, are cross sticks, about three-eighths of an inch square, for supporting the comb; *c* is a piece of comb fixed in the frame for a guide; *g*, *g*, are two iron staples, by which the frame is secured to the floor-board. Fig. 4, represents one of the outer frames containing two panes of glass, A and B, each eighteen inches high and twelve broad, fixed in slender frames which are hinged to the outer-frame, and shut flush with it, resting against a vertical bar, C, which is half an inch square. When the two outer frames are applied and fastened by means of hooks and eyes, one on each side, to the inner frame containing the comb, the distance between the glasses is exactly twenty lines, or $1\frac{2}{3}$ of an inch. The panes being made to

open is indispensable for experimental operations, such as seizing the Queen, cutting out brood-comb, &c.; D, D, are shutters $1\frac{1}{2}$ inch in thickness, which render unnecessary the surtout described by Feburier, and are much more convenient. Fig. 5, is the floor-board, which has the entrances—for there are *two*, one on each side—in the thickness, sloping upwards to the centre of the floor; A, A, are two iron rods which keep the hive firm on its board, by passing through the two staples in the centre frame. Fig. 6, is the hive mounted on its floor-board, with its shutters closed; B, is the roof, sloping on each side, and fastened by a hook and eye at each corner. The whole turns on a pivot, C, which is the upper end of a post driven into the ground. Fig. 7, is the hive seen in profile. When the observer is satisfied with inspecting one side of the comb, he may wheel the hive round and examine the other, without changing his station, taking care, before turning it, to open the door nearest to him, and shut the other immediately after. By this mode of proceeding he may contemplate his favourites at his leisure, without disturbing them, and without the slightest danger of being annoyed by them; for it is true that they become so much accustomed to the opening of the shutters that the admission of the light ceases to disturb them. Feburier speaks of the difficulty of introducing the bees into this hive—the difficulty is very trifling. Raise the hive three inches from its board, supporting it below by a lath of wood, placed on edge, two feet long and three inches deep; there will thus

be an opening along the whole front three inches high. Rest the edge of a board, two or three feet square, on the floor of the hive; on this board place the common hive, into which the bees have been received on swarming; give a smart stroke on the top, and the bees will fall down; remove the common hive, and they will hurry as if for shelter into the other, and in a few minutes the whole will be ensconced in their new habitation. Should they linger longer than is convenient, a puff or two of smoke will cause them to ascend with great speed. A guide-comb must be fixed in this hive, before peopling it.

Since this work was ready for the press, the writer has seen a Treatise on Bees, by Mr. Nutt, a gentleman of Lincolnshire, in which he describes and recommends a hive of his own invention. It consists of three boxes, placed collaterally, each twelve inches square and nine inches deep. The central one, which is, somewhat affectedly called "the Pavilion of Nature," constitutes the grand breeding apartment; while the other two, to which there is access from the pavilion by horizontal openings made in the ends for that purpose, form the chief honey magazines. In the management of this hive, the pavilion is left untouched, and the wings, or collateral boxes only appropriated. When the population of the central box, at the beginning of summer, has increased to such a degree as to raise the internal temperature to 100 degrees of Fahrenheit, the slides inserted between the centre and end boxes are drawn up, and access to the latter given to the bees; by which means the temper-

ature is lowered, room is given to the fast-augmenting population, and the necessity of swarming avoided. And that the Queen may be deterred from depositing her eggs in these end boxes, and thus deteriorating the quality of the honey, a degree of coolness, incompatible, according to this writer's theory, with the rearing of brood, is produced by ventilation; and this is effected by two openings, one at the top and the other at the bottom of the boxes, covered with pieces of perforated tin, and fitted with moveable shutters. For the convenience of using a thermometer, a perforated tin tube, fixed at the top, reaches down into the centre of each box. Into this tube the instrument is inserted from time to time, in order to ascertain the temperature. The quantity of honey said to be taken from one set of these boxes in one season (1826) is enormous—not less, the author avers, than 296½ lbs., while 109 lbs. were left to the bees. Nay, it appears from a register given in the work, that in the season above mentioned, one of the boxes, weighing 52 lbs., was filled in four days! If there is no mistake here, we can only conclude that the author's residence must indeed be in a land flowing with honey.

On the management of Bees in Spring.—About the first or second week of February, unless when the season is stormy, the bees will be observed venturing cautiously to the mouth of the hive; and if the sun shines out about mid-day, the little eager foragers will be seen spreading their wings joyfully,

launching forth into the air, though with a low timid flight, and roaming from bush to bush in search of some plant that may yield a modicum of farina—for the Queen has already begun to lay the eggs of workers; and although there is always a certain quantity of this kind of food in the hive, (the product of the preceding year's gathering) for the coming brood, the provident insects are aware that an additional supply will be required, and rouse themselves accordingly from the winter's inactivity. The collection of farina, however, is, at this early period, very scanty. The few bees that are seen, during the month of February, entering their domiciles with their yellow loads, derive them almost solely from the snow-drop, the crocus, and the furze-blossom. Some other early flowering plants are sometimes to be met with—such as laurustinus, hellebore, and spring flowering heath, but these are not common, and in fact are found only or chiefly in spots where they have been planted for the special benefit of the apiary. At this early period, therefore, the owner cannot help them, however anxious to do so, as far as farina is concerned. In other respects, however, equally important, he has it in his power to minister essentially to their welfare, namely, by supplying them plentifully with honey or syrup of sugar. In the article of honey, none of the insect families of a judicious bee-master will be deficient; he has, it is to be presumed, kept none as stock-hives which did not possess stores sufficient, and more than sufficient,

to carry his bees through not only the winter months, but those of spring also. But even to the well-provisioned, a little additional supply will be welcome, and prove advantageous, infusing fresh spirits into the hard-working labourers, encouraging the laying of the Queen, and consequently contributing greatly to the rapid increase of the population, and to the production of early swarms. We need not fear being over-liberal; the bees are excellent economists and will carefully husband what we entrust to them.

The first care of the cultivator, after the appearance of his bees in spring, is to inspect his hives. Lifting them gently from the stool, he will sweep away all the dead bees, eggs of moths, scrapings of wax, mouldiness, or other offensive matters that have accumulated during the winter, and clean and dry the floor-board effectually. The lower part of the combs, where the population is scanty, is sometimes found to be mouldy; it will save the workers much trouble, and contribute to their health, to cut those parts away. Let the cover, if of straw, be next taken off; mice are often found lodging between it and the hive, and, secure from observation, work their way down into the interior. The cover should be renewed, and carefully fastened close to the hive by one or two wooden hoops. As the consumption of food in spring is very great, in consequence of the prodigious quantity of brood reared—the queen laying at the rate of 100 to 200 eggs daily—the cultivator must see that there is an abundant supply, and commence feeding, if there appears any thing like a

deficiency.* No branch of bee-management requires more attention than the feeding operation, and very many hives, we fear, are irretrievably injured by the injudicious manner in which supplies of food are administered. Giving them in a cold state, or in a state of fermentation, or at improper periods, costs every year the lives of thousands of bees. No food should be given in spring till the bees shew by their coming abroad, that it may be offered them with perfect safety. A simple mode of feeding is by means of a small drawer, having a float pierced with holes, inserted in the thickness of the floor-board, at the back of the hive. Liquid honey, or syrup of sugar, a little warm, may be poured into this drawer in the evening, after the bees have retired in-doors from the labours of the day. It is taken up immediately, and the smell is completely gone before the morning.

It is of very material importance in feeding, to guard against the admission of stranger bees to the feeding vessel. This may be effected by shutting up the hive completely after the feeding-drawer, above described, has been inserted, allowing only the admission of air. One circumstance, however, may render this precaution abortive; some of the liquid may be, and very often is, accidentally spilt in pushing the trough inwards, the consequence of which is, that the smell of the syrup, when the hive is opened, will attract

* The food given to bees in autumn may be either honey or sugar; but in spring it should always be honey, as sugar does not form so good an ingredient of the jelly which nourishes the young brood.

strangers, and eventually lead to plunder. It is a good method, therefore, to administer the food, when it is given at the external entrance, in a covered vessel, having its opening at one side placed close to that of the hive, so that the bees proceed directly to the trough, without having any communication with the open air, and, consequently, without affording an opportunity of admittance to strangers. A trough of this kind is described in the Edinburgh Encyclopædia, and, with some little improvement, by Howatson. We have used it, and found it to answer pretty well, and shall, therefore, for the benefit of others, describe it here. (See Pl. XIII. fig. 3.) "It consists of an oblong box, in one end of which is a reservoir containing honey that is allowed to flow from the bottom, under a thin float, buoyed up with cork, and perforated with small holes, through which the bees, standing on the float, supply themselves with the honey. There is a hole in the side of the box, which is to be applied to the entrance of the hive for admitting the bees above the float, and another on the opposite side which is opened at pleasure, to allow them to escape, should the box be too much crowded. The lid of the box is a glass pane. On pouring the honey into the reservoir, the float rises, whence there should not be such a quantity as to raise it close to the lid or pane above. The box is about 10 inches long, 4 broad, and $2\frac{1}{2}$ deep, and the reservoir is an inch wide. When used, the hole in the side is to be placed close to the entrance of the hive, which must be gently rapped on, if the bees do not immediately find the way down. It is entertain-

ing to observe bees accustomed to be fed in this manner watching the approach of the feeder. When the ordinary time draws near, they rush down to the box the moment it is put upon the board, and, after speedily filling themselves, they return to the hive, from which they very soon return for a second supply. By throwing a little fine flour on those leaving the box, it will be seen that they can fill themselves in three minutes, and are absent not above five. One convenience that attends feeding with such a box, is the exclusion of stranger bees, as the sole communication with the interior is from the entrance of the hive." This is a very good contrivance, generally speaking, but there should be no hole for allowing the bees to escape from the trough or box when over-crowded, as, if left open for a minute through neglect, it would give occasion for the very evil intended to be guarded against, namely, the admission of strangers; for what affords the means of exit to the former will admit the entrance of the latter. There is no need of cork to buoy up the float, which, if made, as it should be, of thin light fir, will be sufficiently buoyant of itself. It may be remarked, also, that there is no danger of filling the box so full as to crush the bees against the glass cover; the describer must have forgot that the entrance-hole intervenes, above which the liquid cannot rise. The usual mode of supplying the bees by this trough is to give the food in the afternoon or evening, when all are within doors, and to remove it early next morning. This mode of feeding, however, ought, as already stated, to be had recourse to only in

mild weather. If the nights be cold, there will be found in the trough next day, many dead bees which had been tempted to linger there too long.

As the season advances, the spring flowers appear in greater abundance, the gooseberry and currant bushes furnish both honey and farina, the seeding turnips and early sown mustard present a very considerable supply; the furze, also, is in full bloom, and the bees become less dependant on artificial feeding. But, unless the weather be remarkably mild, and the stocks of more than ordinary richness, the adventitious supplies ought not to be withdrawn till the beginning of May. During March and April, the activity and bustle of the hive are greatly augmented, and the industrious foragers may be seen in a genial morning hurrying with their loads into the hive in crowds, and jostling and driving one another about with most unceremonious haste. In a strong hive, from 50 to 70 bees, as already stated, may be observed entering in a minute; and, when about to purchase a hive, we cannot have recourse to a more decisive testimony of its strength than the numbers that enter loaded with farina in a given period of time. It is, in fact, during this season, about the beginning or middle of April, that such purchases can be made with less risk than during any other part of the year. The winter is past, and the more trying season of early spring, especially the latter half of February and the whole of March, during which periods more bees die than at any other. Their consumption of honey is then so great, from the circumstance of the Queen having

begun her laying, and the rapidly increasing quantity of brood, that none but well provisioned hives can support the expenditure. In April, however, the industrious insect begins to get something out of doors; besides the gooseberries and currants, the seeding turnips and furze, the willows are putting forth their catkins, and the buds of the plane and horse-chestnut are swelling, all of which contribute to relieve the winter magazines and render it quite safe for a buyer to set about forming his apiary. Let him, therefore, choose a fine morning, when the bees are busily engaged in carrying in farina, and observe attentively, and in their turn, all the hives from which he is to select his purchase, counting the number of each that enter within a minute's space. He will fix, of course, on those that exhibit the greatest number.

The cultivator will sometimes at this season discover, to his mortification, that one or more of his hives has been totally deserted by the inhabitants. If there is no want of honey in the combs, and no appearance of mice or other vermin having obtained access to it, the probable cause of this desertion is the death of the queen during the winter, from age or from accident. In such circumstances, the whole population will gradually leave their habitation ; and while many wander about in the cold, and ultimately perish, others may be seen dispersing themselves among the other hives in the apiary. The owner should in this case shut up the hive, carry it into a dry place, and reserve it for a late swarm, to which it will be a valuable acquisition. It is worthy of remark how

seldom the prosperity of the apiary is affected by the death of a queen; yet, supposing the duration of her life to extend to four years,—and we have no certainty of its being of longer continuance,—in every collection of four stock hives, there must be, on an average, one death each year. And yet how seldom are we aware of this event, or suffer any diminution of our stocks in consequence! We can account for this only by concluding that the death of the queen from age, takes place much less frequently in winter than in summer, at which season eggs may have been already laid in royal cells; or, at all events, there being then common eggs and brood of all ages in the hive, the bees have it in their power to rear a successor from the larva of a worker. And the males being at the same time in great numbers, impregnation of the young queen soon takes place, eggs are laid forty-six hours afterwards, and the business of the community goes on without further interruption.

Bees are confessedly a very irritable race, and in our frequent inspection of the hives at this season, as well as in our operations with them throughout the year, we are sometimes made to feel their fury, and to smart under the venom of their stings. Almost all bee-masters are of opinion that the anger of the bees is greatly excited and aggravated by the odour of their own poison.* Feburier thinks that this venom is more or less active according to the temper-

* The venom of bees is extremely active; Reaumur conjectures that the weight of a grain would kill a pigeon in a few seconds.

ature of the atmosphere, and the temperament of the body which is stung; and he tells us farther, that the bees are more peaceably disposed in temperate climates, than in those where the heat is extreme.* For this he gives the authority of the Abbé della Rocca, who asserts that these insects are not so irritable in the comparatively moderate climate of France, as they are in the Grecian Islands where he had resided; and in proof of this he gives one or two anecdotes which are worthy of being recorded. A small privateer with 40 or 50 men, having on board some hives made of earthen-ware full of bees, was pursued by a Turkish galley manned by 500 seamen and soldiers. As soon as the latter came alongside, the crew of the privateer mounted the rigging with their hives, and hurled them down upon the deck of the galley. The Turks, astonished at this novel mode of warfare, and unable to defend themselves from the stings of the enraged bees, became so terrified, that they thought of nothing but how to escape their fury; while the crew of the small vessel, defended by masks and gloves, flew upon their enemies sword in hand, and captured the vessel almost without resistance. The Abbé's next anecdote is nearly as extraordinary. When Amurath, the Turkish emperor, during the siege of Alba Græca, had battered down part of the wall, and was about to take the town by assault, he found the breach defended

* This is an error, if we may believe the accounts which travellers within the tropics have given of the bees in those regions.

by bees, many hives of which the inhabitants had stationed on the ruins. The Janissaries, although the bravest soldiers in the Ottoman empire, durst not encounter this formidable line of defence, and refused to advance. "*Our* bees," says M. Feburier, in remarking on these anecdotes, "are not so terrible. Still, if we place ourselves within a few feet of a hive to examine them, and do not carefully avoid all hasty movements, we shall very soon perceive one or two bees wheeling rapidly round us, with a shrill and piercing sound, very different from their ordinary humming. In this case it will be prudent to take ourselves off, or plunge the head into a bush, because the number of the assailants will increase rapidly, and the attack commence without a moment's delay. If, notwithstanding the shelter of the bush, they continue their enraged buzzing around us, it will be most prudent to get quietly and quickly out of the way."

The following anecdote from Lesser, quoted by Kirkby and Spence, will shew that even in the temperate climate of Europe, the irritability of this insect may be made a formidable means of defence. "During the confusion occasioned by a time of war in 1525, a mob of peasants assembling in Hohnstein in Thuringia, attempted to pillage the house of the minister of Elende, who having in vain employed all his eloquence to dissuade them from their design, ordered his domestics to fetch his bee-hives, and throw them in the middle of this furious mob. The effect was what might be expected; they were immediately put to flight, and happy to escape unstung."

Almost every writer on the subject of bees has given a cure for their sting, and a recipe for a bee-dress. As remedies against the venom, olive-oil, vitriol, laudanum, vinegar, and even simple water, have each their advocates; and old Butler prescribes the rubbing the wound with simple saliva. We have found no remedy so efficacious as the juice of a plant we have seldom to go far in search of, the common dock, bruised, and rubbed instantly on the wound, after the sting has been withdrawn. The rubbing should be continued for ten or fifteen minutes; it will allay the pain, and very generally prevents the part from swelling. With regard to defensive coverings, we have seen none described which were not greatly wanting in simplicity and facility of management. Many of them, also, are very uncomfortable to the wearers, particularly the cloth hoods which reach down over the shoulders, and by confining and concentrating the heat of the body and breath about the head and face, give more annoyance than a few stings would do. We have tried most of these dresses, and have laid them aside; and now we use only a thin gauze or crape veil, sewed quite round the edge of the hat-rim, the projection of which keeps the veil at due distance from the face. To prevent the bees from getting within it, the sides of the veil are sewed together behind, and the under part of it stuffed within the neck of the vest. This, with a pair of stout leather or woollen gloves, forms our whole defensive armour; it is put off and on in a few seconds, and proves perfectly sufficient for the purpose intended.

On the Management of Bees in the Swarming Season.—The approach of this interesting season is indicated to the Bee-master by the appearance of the drones or males, which shew themselves about the end of May or the beginning of June, sooner or later, according to the general nature of the climate, and the particular state of the colony to which they belong. In the meantime, the population has increased rapidly, and the heat of the hive is greatly augmented. Excited by these causes, the queen hurries over the combs from one quarter of the hive to another, communicates her agitation to her subjects, and, accompanied by a multitude of them, rushes out of the hive. (See p. 138.) The bee-owner is forewarned of this revolution by several not insignificant signs. In many cases, for several preceding days, the bees have been hanging in clusters from the mouth of the hive, as if unable to find room within, and desirous of seeking a new domicile; on the morning of the day on which the emigration takes place, they may be observed listless and idle at the entrance, frequently entering within the door, and returning in small parties of two, three, or four, seemingly insensible to the fragrance exhaled from the rich flower-vegetation, and testifying none of their usual activity in profiting by it; while, as the day advances, the males, on the other hand, are hurrying to and fro with a prodigious bustle and noise, as if conscious of some revolution impending in which they would have to bear a prominent part; and, lastly, the moisture or *sweating*, as it is called, which, in the early part of the day,

had covered the alighting-board like a heavy dew, is rapidly dried up by the great increase of heat.

A swarm on the wing is a most agreeable spectacle to the Bee-master. It is true his harvest of honey might be more plentiful, were the population to remain undivided, and be accommodated with additional room, either by means of storifying or collateral hiving; still, to the lover of nature, the development of the instincts and habits of this interesting insect, which takes place in the process of swarming, is a source of genuine pleasure. At the same time, it must be owned, this pleasure is not always unmingled with anxiety, for his winged favourites sometimes mount high in the air and fly off, perhaps to a habitation previously chosen, and to which they are guided by their scouts. To prevent this evil, the owner and his assistant must hasten to throw up amongst them handfuls of small gravel or earth, which has generally the effect of bringing them down. If it fail, and they seem determined to travel, the owner must prepare himself to follow; for the insects, when thus disposed to wander, condense their straggling circles, and dart off with great rapidity, always in a straight line, and generally against the wind. To put a stop to their flight, the common practice is to make all sorts of noises, ringing of bells, beating of pans and other sonorous vessels.* Long

* Butler thinks that these noises were originally intended to proclaim to the neighbourhood that a swarm had risen, and that they might know whence it came, and to whom it belonged.

experience has satisfied us that the use of these noisy implements is by no means indispensable on such occasions. Ten swarms out of twelve, if let alone altogether, and suffered peaceably to take their own way, will alight on the first shrub, bush, or low-growing tree, that stands in nearly a direct line from the mouth of the hive, whatever may be their intentions as to any ulterior destination; and to defeat such intentions, if any such are threatened, let the swarm, as soon as it has settled on an accessible spot, be housed immediately, and shaded carefully from the sun. In half an hour afterwards, let it be removed to its permanent station in the apiary. If the swarm settle on the branch of a high tree, let a ladder be got and fastened to the trunk by ropes, and let the operator ascend it, carrying up with him a small bag, distended within by a slender hoop in which he will inclose the swarm. The operation will be facilitated, if the branch can be cut and brought down along with it. Sometimes the swarm, after alighting, returns in a few minutes to the hive. This happens when the queen has left, as she sometimes does, the settled group, and makes her way back to her original abode; the swarm will, in these circumstances, gradually follow her and return also, but will come off again next day, or perhaps the same day. Sometimes the bees return to the hive without alighting at all; and sometimes, unfortunately, the queen in such a case commits a mistake and enters a wrong one, while her followers crowd after her, and alight in myriads about the mouth and round the pedestal, without, however,

entering with their sovereign, as if aware of the danger of such intrusion. This is rather a perplexing state of things, and the best remedy we can suggest, is instantly to carry off the hive into which the queen has strayed, and to substitute in its place the one from which she had issued. The bees will readily enter; after which the two hives may be restored to their former places. If the strayed queen does not reappear in a very few minutes, we may conclude she has fallen a victim to her error; and the owner may console himself with the knowledge that the swarm will come off again in a very few days, with another queen.

Two swarms sometimes leave their hives at the same time, and in such cases almost always go together. If they are second swarms, it will be better to let them remain so; they will, when thus united, form a strong stock, and will collect much more honey than they could have done separately. If they are first swarms, and the season is not far advanced, it will be expedient to separate them; and for this purpose, let the whole mass be first received into an empty hive, and then, spreading a sheet on the floor of an empty apartment from which the light is partially excluded, let the hive be placed on it; a smart stroke on the top will send them down in a mass upon the sheet, and the bees, in a minute or two, will be observed collected into two groups, in the centre of each of which will be found a queen. Place an empty hive gently over each group, raising one side, that the bees may have easy access; and when housed, remove them to their proper stations, which should be some consider-

able distance apart. The reason for recommending a partially darkened room is, that should the operation be performed in the open air, as is sometimes done, and in sunshine, the swarms will almost certainly rise again, and very probably may be lost.

Second Swarms.—In ten or twelve days after the departure of the old Queen with her followers, the hive is in a state to send forth another band of emigrants. The young Queen, thwarted by the workers in her attempt to destroy her rivals yet in their cradles,* traverses the combs in every direction in a state of great agitation, causing by her impetuous courses disorder and confusion amongst the inhabitants, and thereby raising the temperature of the hive to such a height, that the bees, unable to support the augmented heat, hurry along with their irritated Queen towards the outlet of the hive, and depart. As there are often from six to ten queens, and sometimes even more, in the hive, two or three will often be found in a second swarm, which has frequently the effect of dividing it, each portion alighting on a separate bush. The operation of uniting them is simple and easy. Cut the branch which carries the smallest portion, and place it in contact with the other; they will soon unite. Or receive first the one group into an empty hive, and placing it immediately under the other, shake this last down upon them, and the junction is effected. The bees will quickly rid themselves of the supernumerary queen.

Third Swarms.—It is in consequence of this mul-

* See page 95.

tiplicity of queens, that sometimes a third, and even a fourth, emigration takes place from the mother-hive, —the former on the third day after the second, and the latter on the day following. To establish these as separate and independent colonies would be ultimately a loss to the owner,—the swarm or cast itself would do little good, and the parent hive would be impoverished to such a degree as to render it unfit for a winter stock. The third and fourth swarms, therefore, ought to be restored to their original habitation, taking care previously to search for and seize the Queen or Queens, which in these small swarms is not a difficult operation. If the operator is successful in his search, the bees will return of themselves. Even a second swarm is seldom much worth, unless the prime one has been particularly weak, and would be much more productive to the owner, by its continuance in the parent hive. Our fondness for having our apiaries stocked with a great number of hives is apt to make us overlook the disadvantage of having—as we are sure to have by indulging ourselves in this desire—puny stock-hives which give much trouble, and cost a great deal more than they are worth; for in this country, second swarms that come off later than June, seldom do any good, unless they are situated in the immediate neighbourhood of heath, or are transported thither in August or September. He is a wise bee-master, then, who takes but one swarm from each stock; he may, generally speaking, depend on having stronger swarms, and a greater quantity of honey than he would have procured from double the number of

seconds. There is but one way of preventing second swarms, and that is, by giving them more room, and destroying all the remaining royal cells, as soon as it is ascertained that a young Queen has been hatched, to preside over the community. A first swarm departs only on a fine day, when the sky is clear, and the sun shines; a second, or cast, is not so scrupulous. Should the weather become wet immediately after the emigrants have been housed, they must be fed.

Virgin Swarms.—When the swarming season has been early and favourable, a strong first swarm sends forth sometimes a young colony headed by the old Queen. For the first few days after she had taken possession of her new abode, she has laid the eggs of workers in great numbers. Portions of comb containing large cells are at the same time constructed, in which she lays the eggs of males. The workers are thereby encouraged to build royal cells; and, if the weather be favourable, at the end of a month from the time of her leaving her original abode, the old Queen leads off a new band of emigrants. The product of this swarm, if suffered to exist separately, is called *virgin honey*. What has been said of the value of second, third, and fourth swarms, is equally applicable to swarms of this description. Unless in very particular circumstances, they are not only not advantageous, but positively injurious to the general prosperity of the apiary, and should therefore be prevented.

A timid and inexperienced cultivator of bees may

shrink at the description of some of the dangerous operations ventured on with such irritable subjects, and will be disposed on every occasion of this kind to ensconce himself in impenetrable defensive armour. In forming artificial swarms, in depriving the bees of their hard-earned stores, or interfering in any way with the brood, he will do well to protect himself by such means. But in regard to natural swarms, he need be under no apprehension, and this panoply is then quite unnecessary. Every person accustomed to work amongst bees, knows how safely he may go into the midst of a newly departed swarm, not one bee of which will molest him, unless he accidentally crush or injure it during his operations. They are so intent on the great object of their emigration, the acquisition of a new abode, and so sensitively anxious about the safety of their mother and Queen, that what on ordinary occasions would draw forth many a vengeful weapon, now passes utterly unheeded by them; and the cultivator may, in the event of their clustering in an inconvenient spot for being hived, lift them in handfuls like so much grain, without in the least suffering for his boldness.

The following instances, in proof of this, are very interesting, and worthy of being repeatedly brought forward, not only as illustrating a remarkable feature in the history of the Bee, but as being well calculated to inspire confidence in those who are required to work amongst these sensitive creatures at the swarming season. The first instance is from M. Lombard: —"A young girl of my acquaintance was greatly

afraid of bees, but was completely cured of her fear by the following incident. A swarm having left a hive, I observed the Queen alight by herself, at a little distance from the apiary. I immediately called my little friend, that I might show her this important personage; she was anxious to have a nearer view of her majesty, and therefore, having first caused her to draw on her gloves, I gave the Queen into her hand. Scarcely had I done so, when we were surrounded by the whole bees of the swarm. In this emergency I encouraged the trembling girl to be steady, and to fear nothing, remaining myself close by her, and covering her head and shoulders with a thin handkerchief. I then made her stretch out the hand that held the Queen, and the bees instantly alighted on it, and hung from her fingers as from the branch of a tree. The little girl, experiencing no injury, was delighted above measure at the novel sight, and so entirely freed from all fear, that she bade me uncover her face. The spectators were charmed at the interesting spectacle. I at length brought a hive, and shaking the swarm from the child's hand, it was lodged in safety without inflicting a single sting."

This instance, though amusing, must yield in interest to the following from Thorley, an old English bee-master. It has been often told, but, for the reasons already stated, deserves to be repeated:— "In the year 1717, one of my swarms settled among the close-twisted branches of a codling tree, and not to be got into a hive without help, my maid-servant,

being in the garden, offered her assistance to hold the hive while I dislodged the bees. Having never been acquainted with bees, she put a linen cloth over her head and shoulders to secure her from their stings. A few of the bees fell into the hive, and some upon the ground, but the main body upon the cloth which covered her garments. I took the hive out of her hands, when she cried out that the bees were got under the covering, and were crowding up towards her breast and face, which put her into a trembling posture. When I perceived the veil was of no farther service, she gave me leave to remove it; this done, a most affecting spectacle presented itself to the view of all the company, filling me with the deepest distress and concern, as I thought myself the unhappy instrument of drawing her into so imminent hazard of her life. Had she enraged them, all resistance would have been vain, and nothing less than her life would have atoned for the offence. I spared not to use all the arguments I could think of, and used the most affectionate entreaties, begging her with all the earnestness in my power to stand her ground, and keep her present posture; in order to which I gave her encouragement to hope for a full discharge from her disagreeable companions. I began to search among them for the Queen, they having now got in a great body upon her breast, about her neck, and up to her chin. I immediately seized her, taking her from the crowd, with some of the commons in company with her, and put them together into the hive. Here I watched her for some

time, and as I did not observe that she came out, I conceived an expectation of seeing the whole body quickly abandon their settlement; but instead of that, I soon observed them gathering closer together, without the least signal for departing. Upon this, I immediately reflected that either there must be another sovereign, or that the same was returned, I directly commenced a second search, and in a short time, with a most agreeable surprise, found a second, or the same. She strove, by entering farther into the crowd, to escape me; but I re-conducted her, with a great number of the populace, into the hive. And now the melancholy scene began to change to one infinitely more agreeable and pleasant. The bees, missing their Queen, began to dislodge and repair to the hive, crowding into it in multitudes, and in the greatest hurry imaginable; and in the space of two or three minutes, the maid had not a single bee about her, neither had she so much as one sting —a small number of which would have quickly stopped her breath."

The following table of the average number, measure, and weight of Bees, is taken from Key's Treatise—

	lbs.	oz.	dr.
23,000 Bees, constituting a good swarm, will weigh	5	0	0
100 Drones weigh . . .	0	1	0
290 Workers	0	1	0
4,640 Ditto, ...	1	0	0
1,830 Ditto—a pint in measure, .	0	6	5
3,660 Ditto—a quart, . . .	0	12	10

This table is probably not far from the truth ; but in experiments to ascertain the fact with unquestionable correctness, it is very necessary to take into the account the state of the bees at the time when the calculation is made. If they are alive, they weigh less than when dead ; and if weighed immediately after they have emigrated from the mother-hive, allowance, to the amount perhaps of a fifth, must be made for the honey and farina with which they are then loaded.

On Artificial Swarms.—Artificial swarming is not generally practised in this country, owing probably to the want of sufficient practical skill, in most of those who apply themselves to Bee-husbandry. In many cases, however, it might be had recourse to with great advantage, and in some it is indispensable if it is desired to reap the full benefit of the stock. It saves the watching necessary in the case of natural swarms ; and if conducted on right principles, renders the artificial colony quite independent of the casualties to which natural swarms are liable. Moreover, it secures the multiplication of swarms in cases, where if left to the natural process, there would be none. Should a continued tract of bad weather take place about the usual period of swarming, the old queen would have time and opportunity to destroy all the royal progeny,—for the bees never oppose the queen mother in such cases,—and thereby entirely frustrate the hope of multiplication by natural swarms. To avoid this evil we must have recourse to artificial swarming. The general period proper for the operation is about eight or ten days previous to the time

when natural swarms might be looked for. At that time it is likely royal brood will be found in the combs, or at all events, abundance of eggs and larvæ of workers, from which to rear an artificial queen,—and the males are also at this time numerous;—a state of things indispensable to the success of artificial swarming. The mode of operation is various, and has been described by almost every writer on the subject of Bees. With common hives the process is somewhat difficult, and not always successful. The following experiments, however, will shew that it is not impracticable. From the first to the third week of June, our hives had all thrown their top or prime swarms. But instead of sending off their seconds, or casts, ten or twelve days thereafter, as is generally the case, four of them had not swarmed nearly three weeks beyond that period. This was in all likelihood owing to an unfavourable change of weather, which, by delaying the swarming, had furnished the reigning queen with an opportunity of putting to death her intended successors. In this state of things, from the crowded condition of the hives, a mass of bees as large as a man's head, hung from the alighting-board of each, a grievous sight to the apiarian, as these outliers are quite idle. We resolved, therefore, to try artificial swarming with one of these hives, and to regulate our proceedings with regard to the others according to the issue of this. Availing ourselves of the discoveries of Schirach and Huber, we cut out of an other hive a piece of comb of about $2\frac{1}{2}$ inches square, containing eggs and larvæ of

the proper age, and fixed it in a Huber hive which had died out during the preceding winter, and was now full of empty comb. We then removed to the opposite side of the garden, and quite out of sight, one of the hives which had an outlying, or rather out-hanging mass attached to its alighting-board, instantly clapping down in its place on the same board the already prepared hive, and, with the help of a hot sun, forcing the others to enter. They made a tremendous noise, and seemed much disconcerted at finding, instead of the rich combs they had hitherto been familiar with, nothing but empty cells. This agitation was kept up all the day by the continued arrival of those bees which had been abroad when the substitution took place, and who added greatly to the population. At noon next day we inspected the new establishment, and found, to our great satisfaction, that the experiment had completely succeeded. The foundations of three royal cells had been laid in the small piece of brood comb we had given them. In due time the Queen was hatched, the hive prospered, and at the end of the season, we took from it nine quarts of honey. I may observe, that, though it was a Huber's hive we used on this occasion, it would have succeeded equally well with a straw one; the construction of the hive had no influence on the experiment farther than that it rendered it easier to fasten the piece of brood comb, from its being made to open in leaves.*

* We repeated this operation on a common hive this season, (1834,) sending off the artificial swarm immediately to the heath. On bringing it back, three weeks afterwards, we found

From another hive, made of straw, that hung out in the same manner, we extracted a swarm by a method described by some of the older Bee-masters, and with equal success: We carried the full hive into a dark place,—turned it up,—fixed it in the frame of a chair from which the stuffed bottom had been removed,—placed an empty hive over it, joining them mouth to mouth,—and partially *drove* it.* As soon as we perceived that about half of the bees had ascended into the empty hive,—knowing that in these cases the queen is generally amongst the foremost,—we immediately replaced the old hive on its former station, and removed the new one containing the queen, to a little distance. As the former had plenty of eggs and young brood, they were at no loss to procure another queen; while the other having a queen, proceeded to work in all respects as a natural swarm.

With such a hive as Huber's, or any other square-shaped hive that opens in two parts vertically, the

satisfactory proofs of the complete success of the operation. The hive contained a considerable quantity of honey, and, what was of greater consequence to the naturalist, the piece of brood comb which had been inserted, of about two inches square, contained the remains of two royal cells, one of which was open at the end, while the other had its opening in the broadside. From these appearances we infer, that, from the first cell a queen had issued in the natural way, and had succeeded in destroying her rival in the other, effecting her purpose by tearing open the cell in the quarter which afforded direct access to the vital parts of her rival's body.

* By *driving* is to be understood the process of forcing the bees out of a full hive into an empty one. The mode of operating is described at length in page 227.

operation is very simple, more satisfactory, and less dependant on contingencies. Let a hive be prepared of precisely the same dimensions as the one to be operated on, and of the same construction, namely, opening vertically in two halves. Early in the morning, or in the evening, when the bees are all at home, let the hive be gently separated. The bees, always most irritable when idle, will dart out in no placid humour, and must therefore be kept from annoying the operator, by the use of smoke. Apply to each full half an empty one, carefully fastening them together by hooks and eyes previously arranged. We have thus two hives, each half full of bees, brood, and honey. One of them will possess the queen, and the other will have royal brood, or at all events, eggs and larvæ of all ages wherewith to originate a queen. As soon as they have recovered from the panic caused by the operation, and have all retired into the interior, let both doors be closed that there may be no communication between the two divided communities. Two or three hours afterwards, listen attentively to each, and it will be readily ascertained from the quiet state of the one, and the loud disorderly buzzing of the other, that the queen is present with the former, and that the other is distressed at the discovery of their loss. Carry off the one with the queen, and shut it up in a dark apartment for twenty-four hours, leaving the other in the original station. If this last had no royal brood at the time of the separation, it will, within twenty-four hours, have set about forming an artificial queen, and the operation

is finished. The other may now be brought from its confinement, and placed on another pedestal. Possessing a queen, there is little danger of any of the bees leaving it for the other; and even this may be effectually prevented by placing that other in confinement for twenty-four hours, after which time, the hive with the old queen will have become accustomed to their new station.

We have recommended the employment of smoke in the above operation. This is so useful an auxiliary in *every* operation with bees, that it is worth while to ascertain the most effectual and convenient method of using it. Howatson has given a description of an instrument which seems well enough suited to the purpose: "We use," says he, "a fumigating box of tin, of the form of which we cannot give a better idea, though rather a ludicrous one, than supposing it an old shoe, with a hole in the toe, and a spur on the heel; the mouth of this shoe, moreover, is covered with a hinged lid. The spur is a tube communicating with the interior, for receiving the pipe of a pair of common hand-bellows, the blast of which drives the smoke forward through the hole in the toe into the skep. The burning rags, or other materials for producing the smoke, lie directly under the lid, and a piece of moveable perforated tin is put in near the mouth, so as to intercept the sparks which would otherwise be emitted, and burn the bees or melt the combs. This fumigating box is ten inches long and three broad; it is two inches deep at the heel, and tapers gradually down

to a quarter at the toe. It is to be particularly attended to in the construction, that there be as few joinings as possible, and these are to be fastened with rivets instead of solder.* We have made what we think an improvement on this instrument,—not on the principle, but on the shape, and the mode of using it; and have given a figure of it in Pl. XIII. fig. 2. A is the body of the instrument, having a bottom at B, perforated with small holes, through which the smoke of burning rags, or of tinder, or of dried cow-dung, made damp before being used, placed inside at A, will be blown out at the point C; D is the lid which slips on the body, after the rags are kindled within, having a tube E treble the diameter of the opening at C. The rim of the lid is perforated with holes $\frac{1}{2}$ inch in diameter, corresponding to the same number of holes in the body of the instrument, the use of which is to admit the air by bringing the holes over each other, and thus to prevent the fire from being extinguished, when the operator occasionally lays it out of his hand. When about to resume it, a half-turn of the lid, by breaking the correspondence of the holes, will again exclude the air; F is a ring by which the instrument is held; if an assistant is at hand, he may insert the nozzle of a pair of hand-bellows into the mouth of the tube E, and thus add to its efficiency. The instrument is made of tin, having all the joinings rivetted instead of being soldered. It is on a scale of six or seven times the dimensions of the figure.

* Howatson on Bees, page 62.

It is almost needless to add, that if the operator be a smoker of tobacco, a few whiffs from his pipe will answer the purpose better than either of the modes above described.

On Deprivation and Transportation.—The swarming season terminates, generally, about the first week of July, a few days sooner or later, according to the climate, and the temperature of the season. After that period, no emigration ought to be allowed; or if it take place in spite of our endeavours to prevent it, the swarms should be restored to the mother-hives. The massacre of the Males, which takes place about the beginning of August, seems to afford a not unequivocal symptom that the richest part of the honey-season is nearly over, and that the bees are aware of the necessity of cutting off all unnecessary expenditure of food. Those cultivators, therefore, who pursue the system of appropriating a portion of the honey accumulated during the summer-months of June and July,—who content themselves with a *share* only of the fruits of Bee-industry, and who make use of hives conveniently constructed for this purpose,—or who have an opportunity of availing themselves of the near neighbourhood of heath,—may now proceed with the process of deprivation.

The use of storied hives, of Huber's, and of others which divide vertically into halves, renders this process very simple. The quantity of honey in hives of this construction can be at all times accurately ascertained; so that it can be seen at once whether there be any available surplus, and what combs, as

containing brood, must be carefully preserved. The upper box in storied hives is then free from brood, and may easily be removed, not only without present detriment to the inmates, but almost without their knowledge. The *modus operandi* will be pointed out afterwards. It is not impracticable to accomplish deprivation with the common straw-hive; but it is attended with so much difficulty, and is so liable to failure, that it is seldom attempted. The mode of proceeding, however, as recommended and practised by Wildman, is to remove the full hive into a darkened room, and by repeated strokes on the outside, to force the bees to ascend into an empty one, placed immediately above the other; after which the deprived bees are removed to their usual stand in the apiary. In the mean time the operator, with a thin pliable knife, cuts out the full combs, and scrapes off with a spoon what may have escaped the knife; he then returns the bees to their old hive. To the great mass of those who cultivate bees, this operation appears troublesome and dangerous; and where it is attempted, it often fails, from the desire of appropriating too large a share of the stores, and from the destruction of the brood-combs. In certain circumstances, however, the operation, when done judiciously, may, even with straw-hives, be done with safety; and that is when the deprived hives are to be immediately removed to the vicinity of heath. Change of pasture is most advantageous to these insects at this season; for while the flowers in one district have entirely faded, those of another may be in

full bloom. In corn-districts, especially, this change is indispensable. After the middle of August, wide tracts of the richest arable lands, unless in the immediate vicinity of heath, present to the bees but a barren desert; the wild flowers are almost all gone, and in those that still remain, the secretion of honey proceeds very slowly and scantily. And what is of still more importance, the white or Dutch clover, which, in a highly-cultivated country, forms the great dependence of the apiary, has disappeared; and hardly any thing remains but the small patches of mignonette in the gardens, and the coarse rag-weed or mug-wort in the fields.

From this period, accordingly, the hives, generally speaking, become every day lighter; and the Bee-master, especially after deprivation, must exert his skill in checking the evil, otherwise his stocks will be unfit to stand the winter. The only remedy,—at least the best,—is to transport his hives to a district where the bees will find those supplies that are wanting at home.

The practice of removing bees towards the close of autumn to fresh pastures prevailed in ancient times, as we learn from Columella and others,—and is continued at the present day, with great advantage to the owners. In China, Egypt, the Grecian Islands, and over almost the whole European continent, we find the transporting system highly approved of. In England we know not that its advantages are appreciated as they deserve to be; but in Scotland,

the practice is almost universal. One instance is thus stated by a friend.* "About five miles from Edinburgh, at the foot of one of the Pentland hills, stands Logan-house, supposed the former residence of Sir W. Worthy, celebrated by Allan Ramsay in his Gentle Shepherd. This house is now occupied by a shepherd, who, during July and August, receives about 100 bee-hives from his neighbours beyond the hills, that their bees may gather the honey from the luxuriant blossoms of the mountain heather."

The exact period when transportation is to be had recourse to, must be regulated by the localities, and by the temperature of the season. But in general, the Bee-master will act safely if he adopt the decay of the white clover as the signal of removal. At that period, the heath is coming into bloom, and soon presents a rich fund of sweets to the eager collectors. By transporting them thither, a double harvest may be reaped. In the autumn of 1828, we took nearly the whole stores from a few hives, before transporting them to the moors; and on bringing them back, after an absence of about three weeks, they had acquired at an average ten lbs. of honey each. Double this quantity in the same period of time, if the weather is dry and sunny, is by no means uncommon, as the fruit of transportation. But much depends on the season; and the rains so often prevailing in August and September, frequently disappoint the expectations of the owner. In 1829, during the autumn of which

* Dr. Bevan

the rains were unceasing, though never very heavy, we sent four hives to the heath; but brought them back again considerably *diminished* in weight.

Along with the deprived hives—that is, those from which a portion of their stores have been taken,—there should be sent to enjoy the benefit of change of pasture, such swarms of the season as had emigrated late, or had been unusually small; and to give them a better chance of success, two of this description should be united before their removal. Their station on the new pasture-ground should not be less than three miles distant from the apiary, otherwise they may find their way back to their original resting-place, and perish. The flight of the Bee, according to Huber, extends generally about half-a-league. If that Naturalist meant a German league, as he probably did, according to this calculation, a bee will fly at least two English miles in quest of food. The proof of the correctness of this opinion is given in a note by M. Lombard and in an unpublished letter of Huber, of date April 1810, which is quoted by M. Lombard in his Treatise. "At the time of the revolution, M. Huber lived at Cour, near to Lausanne. He had the lake on one side of his domicile, and vineyards on the other. He soon perceived the disadvantage of his position (as regarded his bees.) When the orchards at Cour had shed their blossoms, and the few meadows in the neighbourhood had been mown, he found the stores of his stock-hives diminishing daily; the labours of the bees ceased so entirely, that even in summer they

would have died of hunger had he not succoured them. In the meantime, while matters were going on so badly at Cour, the bees at Renan, Chabliere, Vaux, Cery, &c.—places at the distance of only half-a-league,—were living in the greatest abundance, threw numerous swarms, and filled their hives with honey and wax." This fact serves as an evidence that the flight of a bee, in ordinary cases, is less than two English miles; though we readily admit that in some rare, though well authenticated instances, they have been known to fly double that distance. The general fact is farther confirmed by the following sentence in Huber's letter: "If my bees," he says, "could have cleared the interval which separated them from the places where they would have found provisions, they would assuredly have done so, rather than die of hunger. They succeeded no better at Vevai, although it is not more than half-a-league from that place to Hauteville, Chardonne, &c., where they throve remarkably well."

General Honey-Harvest.—About the beginning or middle of September, the transported hives are brought back to their usual station; and in a few days, according to circumstances, the general honey-harvest commences. The bees have relaxed greatly in their labours,—the fields no longer tempt them to go a-foraging,—and already the little economists are forced to break in on their winter stores. The hives, therefore, designed to be reserved as winter stocks, must be inspected and weighed. Every one which weighs not fifteen or sixteen lbs., exclusive of empty

hive or skep, bees, brood, &c., ought without hesitation to be rejected. A less quantity by two or three lbs. may bring them through the winter, but this will depend much on the nature of the season; whereas, with the quantity above stated, there is no doubt at all of their preservation as far as food is concerned, whatever may be the temperature. During frost, the bees consume very little indeed; and if the cold increase in severity, still less, if any. But as we cannot anticipate what the temperature of the ensuing winter may turn out, our wisdom is to take care before hand that there be no deficiency in their stores; it cannot be supplied when the cold has actually set in. A common straw-hive weighs when empty from five to six lbs.—an ordinary swarm about four lbs.,—the wax of a full hive of the current year nearly two lbs.,—of the preceding year, at least three lbs.,—and the farina in the cells not less than one lb., making in all about fifteen lbs. A stock, therefore, to be secure, ought to be double that weight in the gross, that is, should contain not less than fifteen lbs. honey.

Having selected the stocks, the Cultivator who does not practise the mode of partial deprivation, alluded to in last chapter, will now reap his general harvest. There are three modes of taking the honey, each of which has its advocates; namely *Partial Deprivation,* applicable to storied and leaf hives; *Suffocation,*—and *Driving,* that is forcing the bees to quit their magazines, and uniting the expelled inhabitants to the stock-hives. *Partial Deprivation* consists in appropriating early in the season a portion of the

stores. In preparing prospectively for thus sharing in the products of the hive, the Cultivator who pursues the storifying system, immediately after the swarming season is over, adds another story or box to the two of which his hive consists, placing it undermost, or as it is called by some Bee-Masters, *Nadir-ing.* The brood-combs contained in the uppermost story, will, as the young bees are hatched, be quickly filled with honey, and may be removed about the beginning of August. The top cover is then replaced on the next story in position, which was originally the lower, and is now the upper. In ordinary seasons, the bees will have ample time to lay in sufficient food for winter and spring use, after the abstraction of this portion of their stores. As the combs of the upper box are frequently found adhering by their lower extremities to the bars of the next, it will be necessary, before removal, to separate them by means of a very thin long-bladed knife or a fine wire, (a piano-forté string will answer well,) drawn through the hive at the point of junction. The operator will next expel the bees from this box or story, by lifting the top-cover, and blowing in a little smoke, which will cause the inhabitants to retreat quickly to the lower regions. The box may then be taken away, without the operator running the risk of the slightest annoyance. The same effect may be produced by driving.* The honey found in this removed box, will not be all honey of the current season, and consequently is not so delicately fine. It is also

* See in page 227 directions for the operation of driving.

sometimes found mixed with, or rather deposited above, a layer of farina. Should it be wished, therefore, to obtain a supply free from these imperfections, the empty story which is added, may be placed *above*, instead of *below* the original stock, and the honey will thus be of a superior kind. This mode of operating is called *super*-ing, in contra-distinction to *nadir*-ing.*

This practice of partial deprivation has never yet become general, because it is liable to frequent failure, even in improved hives, and because the full benefit is not derived from it at the very commencement of the system. The liability to failure, the first of the objections stated, is owing in most instances, not to the *mode*, but to the *period* of the operation. According to the too common practice of those who are friendly to deprivation, a portion of honey is abstracted from the hives about the beginning or middle of September; and the owner compliments himself on his moderation in being content with a part instead of the whole, and on his humanity in saving the lives of his industrious favourites; while in nine instances out of ten, he finds, on the arrival of March, that his moderation and humanity have been altogether unavailing; and that he has saved them from a violent death by suffocation, only to expose them to the more tardy, but not less cruel death, by starvation. Whereas, if deprivation take place soon after the swarming season, as already recommended, and is managed with discretion, the issue will be very diffe-

* Dr. Bevan practises Nadir-ing only with young swarms, and Super-ing with those of preceding years.

rent, and ultimately more profitable to the owner, than the almost universally practised mode by suffocation, which is too well known to need description. The latter system may yield a greater return in proportion to the hives operated upon,—but in the former, there is a much greater number of hives available. For example: Suppose two apiaries, each containing five stock-hives at the end of July, exclusive of as many swarms recently thrown. The owner of the one, practising the depriving system, takes from each of his stocks ten lbs. of honey, making an amount of fifty lbs. as his honey-harvest. The owner of the other, an abettor of suffocation, proceeds in September to smoke his five old hives, and receives from each twenty-five lbs. of honey, making an amount of 125 lbs. as his honey-harvest, between two and three times the quantity of the other. In the following year, the Depriver has his five old stock-hives, and the five swarms now become stocks also; from the whole ten he now takes 100 lbs. of honey, while at the same time his apiary is augmented by the addition of ten new swarms, making twenty for the following year; while his rival possesses only his former number of five yielding 125 lbs. In the next year, that is, two years from the commencement of the comparative trial, the Depriver has twenty stock-hives yielding 200 lbs.,—and so on by a geometrical ratio,—while the other remains at his original 125 lbs. This calculation is made on the supposition that each owner takes but one swarm from each stock, and without making any allowance for losses and failures

which will affect the produce of both, in honey and bees, but to which both are liable.

We are now to compare the suffocating system with that by which, even though we defer the honey harvest to the usual late period of September, we may obtain the same quantity of produce, and at the same time save the lives of the bees. "Were we to kill the hen for her egg," says Wildman indignantly, "the cow for her milk, or the sheep for the fleece it bears, every one would instantly see how much we should act contrary to our interest; and yet this is practised every year in our inhuman and impolitic slaughter of the bees." It is mortifying to find writers of some celebrity in this branch of rural economy, defending the practice of suffocation, and using such arguments as the following: "If he who dines every day on a good dish of animal food, does not find fault with the farmer who sold his cattle to the butcher, or who carried them to the market after he had himself cut their throats,—why does he exclaim against the Bee-cultivator who suffocates insects destined by nature to die in the following year?"* Independent of the consideration that the carcase of the bee is not, like that of the sheep or ox, of use after its death, and that advantage may be derived from it while in life, the cold calculating spirit which could approve and recommend such uncalled-for barbarity, seems very inconsistent with the enthusiastic admiration of the insect generally felt by apiarians, and betrays more of the selfishness of the honey-merchant,

* Feburier, Traité des Abeilles.

than the generous feelings of the delighted Naturalist. No doubt, reasoning analogically, we have the same right to destroy our bees, without being liable to the charge of inhumanity, as we have to take the life of our sheep or oxen. Both were designed for our use, and if the death of the animals is necessary to give us the full benefit of what was originally intended for our service, there is no inhumanity in fulfilling the designs of nature. At the same time, our humane feelings must be at a very low ebb indeed, if we can make use of this right without some degree of pain and regret, when the object to be sacrificed to our benefit has been to us a source of innocent enjoyment; nay, it may be reasonably expected, that the interest we feel in that object, will not only prevent us from destroying it wantonly and unnecessarily, but will induce us anxiously to inquire whether the barbarous alternative may not be avoided in perfect consistency with our real advantage.

Now, it is as clear as day, that the advantage of the owner is best consulted by saving the lives of his bees; because, independent of the satisfaction of eschewing the odious task of sacrificing what we have long watched with so much anxiety, and contemplated with so much admiration, the conservative system yields as large, if not a larger produce than the destructive, with this additional advantage, that the honey is not deteriorated by the unwholesome fumes of the sulphur* made use of in suffocation;

* Objections are sometimes made to the free use of honey, that it is very apt to produce disorders in the stomach and

and, in the next place, we have the industrious collectors themselves ready in another season to renew their labours and add to our riches,—and requiring only to be united to some well-provisioned stock-hive which can afford to maintain them. It is pitiable to reflect that the small degree of additional trouble required in uniting them,* should prove so effectual an obstacle to this conservative practice. Yet the operation with each hive so treated, need not occupy more than fifteen or twenty minutes. In the evening when all are quiet, turn up the hive which is to be operated upon, fixing it in a chair from which the stuffed bottom has been removed; place an empty hive above it, wrap a cloth round the point of junction, to prevent the bees from coming out, and annoying the operator; then, with a short stick or stone in each hand, beat round the sides but *gently* for fear of loosening the combs. In five minutes, the panic-struck insects will hastily mount into the empty hive, with

bowels. Some medical men are of opinion that the *sulphur*, and not the honey is the cause of the evil.

On submitting this note to Dr. Bevan, he made the following remarks upon it: "The fumes of sulphur are converted into sulphuric acid, (vitriolic acid,) and the quantity which mingles with the honey is very small. I am fully persuaded, that so far from its causing the honey to disagree with the stomach and bowels, its tendency would be to produce a contrary effect. It is the honey, and the honey only that disagrees; to a greater or less extent, of course, according to the pasturage from which it has been collected. I knew a gentleman who could not be in the same room with uncovered honey without having his bowels disordered."

* The French call this operation "marrying hives."

a loud humming noise expressive of their trepidation. The hives are then separated,—that containing the bees is placed on its usual pedestal,—and the other containing the honey is carried off. The union is next to be effected. Turn up the stock-hive which is to receive the addition to its population,—with a bunch of feathers, or a small watering-pan, such as is used for watering flower-beds, drench them with a solution of ale and sugar, or water and sugar, made a little warm. Do the same to the expelled bees; and then placing these last over the stock, mouth to mouth, a smart rap on the top of the hive will drive them down among the bees and combs of the undermost hive. Place this last on its pedestal, and the operation is completed. The strong flavour of the solution will prevent them from distinguishing between friend and stranger; and their first movement, after recovering from their panic, will be to lick the liquid from one another's bodies. This mode of operating is applicable to all kinds of hives. It will be an advantage, though attended with a little additional trouble, to search for, and destroy the queen of the expelled bees, before the union takes place. Two queens cannot subsist together in one hive. When two hives are united, therefore, what becomes of the supernumerary queen? She is put to death by the bees generally within twenty-four hours from the time of the union. But as the bees are the executioners, it is within the bounds of possibility that both queens may fall a sacrifice. The followers of one queen may seize upon her rival, and destroy

her, in ignorance that their own proper sovereign has been perhaps already put *hors de combat* by the subjects of the other; and, in such a case, the ruin of the whole community will be the ultimate consequence, because at this season there are no eggs nor larvæ, nor males, wherewith to repair the disaster. It is safer, therefore, to search for, and remove the queen of the swarm that has been dislodged, and is to be "married," before the union takes place; she will with little difficulty be discovered and laid hold of in a hive without comb.

The hives denuded of the bees, being now carried into the house, the process of extracting the honey from the combs must commence immediately, while it retains its natural warmth. It will then flow freely, and if there is a fire in the apartment where the operation is carried on, the work will be greatly facilitated. As it is of much importance in preserving the fine flavour of the honey, that it should be exposed as little as possible to the external air, the mode of manipulation pointed out by Bonner, and repeated after him by other writers, cannot be commended. The following is the kind of apparatus we have made use of for a great many years, and find to answer well. (Pl. XIII. fig. 1.) It consists of a tin vessel of an oval shape, (having a spigot at the bottom,) 18 inches long, 7 broad, and 5 deep. Resting upon this, is another vessel of the same shape, and just so much smaller that its under edge slips within the other to the extent of an inch, and is prevented from sinking farther by a raised beading. The bottom

is pierced closely with holes, each the 16th or 20th of an inch in diameter. *Above* the bottom, inside, and at the distance of an inch from it, stands upon four feet, a stage, A, ... of the same shape and size, made of wire cloth, of $\frac{1}{4}$ inch mesh. *Under* the bottom, is fixed a piece of fine muslin, B, the edges of which are brought out at the joining of the two vessels. In using this apparatus, the combs being sliced horizontally through the cells, are laid with the cut side undermost upon the wire cloth stage, which retains all the bulky part of the wax, and prevents it from clogging the holes below; the honey drops upon the bottom, and runs through the small holes which prevent the lesser particles of wax from getting through, while the muslin below causes it to flow in almost perfect purity into the under vessel, from whence it issues through the spigot into the store-jars. A cover put on the top vessel, after the sliced comb has been deposited, completes the exclusion of the external air, with which the honey never comes in contact till it runs from the spigot. The wax is next to be attended to, and there cannot be, perhaps, a simpler and more effectual direction for its manipulation than that which is given by the Abbé della Rocca. The wax is put into a woollen bag, firmly tied at the mouth; the bag is plunged into a pan of boiling water; the pure material oozes through the cloth, and swims on the surface; it is carefully skimmed off, as long as any continues to rise, and poured into a shallow earthen bowl, which is previously wetted to prevent the wax from adhering to

its sides. It must be allowed to cool very gradually, otherwise the cake which it forms will crack; and, therefore, it should be kept in a warm place.

Management of Bees during Winter.—The honey-harvest being now over, it will be necessary to prepare the stock-hives for passing the winter in safety. For this purpose, certain preliminary precautions are requisite, and none more so than to guard against pillage. After the process of separating the honey from the wax, it is usual and economical to carry out to the apiary, the vessels and implements employed in the manipulation; and the bees will readily avail themselves of whatever honey may adhere to them, and clean them effectually. Pieces of refuse comb, also, are presented to them, and in a very short time the industrious insects rifle them of every particle of saccharine matter. Having exhausted these sources, the bees are tempted often by the more than usually strong odour exhaled from the hives in consequence of their recent luxurious feasting, to rob their neighbours of their share of the booty; and a scene of pillage ensues which sometimes ends in the total destruction of the besieged hives. If the colony attacked be pretty strong in population, the evil may be put a stop to, perhaps, by contracting the entrance. Every proper door has one or two small holes at the bottom, which may be opened or shut as occasion requires, just large enough to admit the passing of a single bee. This contracted entrance greatly assists a besieged colony; but the doors are generally so thin, that the robbers often effect an entrance by adroitly slipping

past the sentinel on watch. An improvement, and a very simple one, in the formation of the doors, will increase the difficulty of eluding the vigilance of the guard; make them 1½ inch thick, the small apertures will then be to the bees, in fact, long narrow passages, along which they will be unable to make their way in the face of the opposing sentinel. Doors of this kind should remain on the hives during the whole winter. If the precaution above recommended fails, the hive attacked must be removed for a few days, till quiet is in some degree restored to the apiary; and, in the meantime, to amuse and baffle the assailants, an empty hive may occupy the station. No stock-hive ought at this season to require feeding. Still, circumstances may occur, as in the case of long-continued bad weather during the end of autumn, which may render some supply beneficial and even necessary. In such cases, the best mode of administering it, is to raise the hive which is to be assisted, on a round or square frame of wood, two or three inches deep, and place in the vacuum thus produced, two or three pieces of full comb on edge, and in their natural position. The bees will soon drain them, storing the contents in the upper region of their domicile, after which the frame and empty comb may be removed. In default of comb, syrup must be supplied, as directed in page 186.

It is almost needless to say, that feeding during winter is out of the question, even though the season should be mild. It is unnecessary, and would prove injurious, tempting the insects to leave the compara-

tively warm atmosphere of the centre of the hive where they are congregated in dense clusters, and to expose themselves to the colder temperature below which chills, and ultimately destroys them. At the same time, we must not be understood as recommending the shutting them up altogether, so that they cannot take the advantage of an occasional interval of sunshine. Leave the narrow apertures free, both in order to admit the fresh air, and to afford the bees an opportunity of coming abroad when they can do so in safety. Absolute confinement is extremely prejudicial to them. The practice which prevails in some places of removing the hives into the dwelling-house, by way of preserving them from the cold, is by no means to be recommended; and, in fact, is often followed by fatal effects. The increased temperature of the place to which they have been removed, keeps them in such a state of animation and excitement, that they continue to eat during the whole period of their confinement, and not being at liberty to go abroad and evacuate, their bodies become swollen and diseased by the retention of their fæces,—for they are most unwilling to soil the interior of their dwelling,—and great numbers of them are thus cut off; and when in spring the hive is brought into the open air, the few inhabitants that remain are too feeble to bear the sudden change of temperature, and gradually dwindle away, or are plundered and destroyed by the more vigorous and healthy.

While snow is on the ground, a gleam of sunshine will cast such a glare of light into the interior of the

hives, that the bees are often induced to venture abroad, and, soon chilled by the cold, they fall in hundreds on the snow, and, if not timely succoured, will ultimately perish. This evil may be prevented in some degree by turning, as soon as winter has set fairly in, the hives round on their stands, so that the entrance may face the north.* If this precaution has not been taken in time, and the unfortunate wanderers are already prostrate on the snow, let them be instantly gathered, placed in a vessel, (a dinner-dish-cover, for example,) having a piece of

* Mr. Nutt, the Lincolnshire Bee-Master alluded to in page 182, gives, in his work, an account of an experiment to ascertain the effect of changing the site of hives from a southern to a northern exposure during winter. He took six hives weighing as under, and placed three on the north side of his house, leaving the other three in their usual situation. In November 1834,

No. 1	weighed	35 lbs.	No. 4	weighed	42 lbs.
2	—	38	5	—	32
3	—	40	6	—	37
		113			111

The first three, Nos. 1, 2, & 3, weighing 113 lbs., remained during winter in their summer situations. Nos, 4, 5, & 6, were removed to a cold dry place on the north side of his house. On the 26th of the following March they weighed as follows

No. 1.	weighed	15 lbs.	No. 4.	weighed	37 lbs.
2.	—	16	5.	—	27
3.	—	19	6.	—	32
		50			96

The three first, therefore, lost 63 lbs., on an average 21 lbs. each ; the three last decreased only 15 lbs., average 5 lbs each. The three last swarmed in May, the three first not till July.

thin muslin spread over its mouth, and held within a yard of the fire. When they recover, which they will do in a few minutes, let them be taken out to the apiary, and the muslin removed, and they will speedily regain their respective habitations.

Once or twice during the winter, the hives ought to be lifted from their stools, and carefully inspected; all cobwebs swept off, the floor-board thoroughly cleaned, and the outer covers or surtouts repaired and adjusted, so that the rain or snow may not gain admittance; the snow, especially, as soon as fallen should be cleared away.

In the preceding chapter, when treating of taking the honey, and at the same time preserving the lives of the bees, we recommended the uniting of the expelled bees to the stock-hives, and pointed out an easy method of accomplishing this union. If the stock-hive be very large, two or even three expelled swarms may be joined to it. In that case it will be prudent to see that there is sufficient provision for so many additional mouths; for nothing seems more reasonable, or more consonant with experience, than the conclusion, that if the population be increased, the means of maintaining it must also be augmented. And yet a very experienced Bee-master has averred, and supports his averments by a minute detail of his experiments on the subject, that it is not necessary the reinforced hive should have double or treble stores in order to supply the wants of its now doubled or trebled population. The fact,—if fact it be,—is rather astounding; however, M. Gelieu, a Swiss

clergyman, author of "*Le Conservateur des Abeilles,*" and the discoverer of this supposed fact, shall speak for himself. We have never put his discovery to the test of experiment—at least with such minute accuracy as to warrant us in drawing conclusions, either affirmative or otherwise. But from the detail which M. Gelieu gives, there appears no great difficulty in settling the point beyond all doubt, whatever there may be in ascertaining the reasons for it, if well-founded. "I expected," says M. Gelieu, "that in doubling the population, it would be necessary to double the supply too. The more mouths, said I to myself, the more need of provisions. I consequently made a considerable addition to the stores of the hives whose population I had augmented; but, to my astonishment, when I weighed them at the return of spring, I found that their consumption had been no greater than that of the single hives. I thought I must surely have made some mistake, and was not convinced of the fact till I had repeated the same experiment a hundred times, and always with the same result. I cannot conceive how an army of 30,000 men can subsist on the supplies necessary for an army of only 10,000, supposing the soldiers of both to have an equal appetite, and equal means of satisfying it. It holds true, however, with the bees; the fact is undeniable; the reason is to me unknown. I leave to minds more penetrating than mine the task of discovering and explaining how two large families, when united, can live at as little expense as either of the two would have done when separated.

Does the increase of heat supply, to a certain extent, the place of food? Does it render their aliment more nutritive? I have reason to believe, that during the winter, and previous to the breeding season, a small hive consumes as much food as a large one. Do the inmates of the small hive consume individually a greater quantity? and is this greater consumption necessary to keep up the requisite degree of warmth? I propose these inquiries to the Naturalist. After this discovery, as important as it is inexplicable, I varied my experiments in order to insure absolute certainty; and to obtain the most unequivocal proofs of the fact, I united three swarms in autumn, and when I weighed the hive in spring, I found that it had scarcely consumed a pound weight of provisions more than a single hive. I went farther. I had a large hive, well-peopled, and amply provisioned. Without removing it from its place, I joined to it the bees of *four* other hives. This enormous population produced so strong a heat, that during the whole winter, which was severe, there was heard from them a loud humming, like that which proceeds from a hive on the evening of a fine day in spring. The vapour expelled by the continual vibrating of their wings was condensed, and formed icicles at the entrance of the hive during the hard frosts. Well, when in spring I weighed this hive, which contained five families, and from which had exhaled so much moisture, I found it but three lbs. lighter than my ordinary hives. It threw excellent swarms, long before the others in the apiary, and I was well re-

paid for my trouble." In proof and illustration of these facts, the author subjoins the following Table, giving a view of the diminution in weight of each of his hives during one winter.

Diminution of weight in each of thirty-six hives, from 20th September 1813, to 31st March 1814:—

No.		lbs.	No.		lbs.
1.	Diminished in weight,	10	27.	Single hive diminished,	10½
2.		10½	30.		13
3,		12½	32.		9½
4.		12	38.		8
8.		11	A.		9½
10.		9	B.		10
11.		8½	C.		12½
13.	A doubled hive,	11	D.		10½
15.		10½	1.	Wooden hive,	11½
16.	A doubled hive,	10½	4.	Doubled hive,	9½
17.	A doubled hive,	14	6.		11
20.		10	7.		8½
21.		14	8.		19
22.	A doubled hive,	8½	9.		10
23.		10½	11.		13½
24.		9	13.		15
25.		15	21.		10
26.		12½	23.	Doubled,	11½

From this Table it appears that the average expenditure of thirty-six hives in six months, was about eleven lbs. each; and that the smallest expenditure in any one hive was eight lbs., and the greatest nineteen lbs. This last difference the author attributes to pillage, and thinks it probable that the straw-hive, No. 38, had enriched itself at the expense of its

neighbours, while the wooden-box, No. 8, had been plundered.

The numbers awanting in the Table belonged to hives from which he had taken the honey, or which he had fed, and were not, therefore, legitimate subjects of experiment.

HUMBLE-BEES.

We have now to notice the nature and habits of another tribe of the social Apidae, familiarly known by the name of Humble-Bees; but so large a space has been already devoted to a more valuable species, that our descriptions must be comparatively brief. Humble-Bees, as far as we know, have never been domesticated, or made directly subservient to the interests of mankind; although it is not improbable that means might be found of turning their labours to account, did not the possession of a more useful species remove all inducement to make the attempt. They constitute, however, a very interesting portion of our insect population for a variety of reasons. Their economy, although greatly inferior in interest to that of the hive bee, is still extremely curious; their comparatively large size, and gay colours, render them conspicuous objects in our fields and gardens; the untiring diligence with which they seek their food among the blossoms "so busy and so

pleased," can hardly be observed without pleasure; while their incessant hum, which often assails our ears in heathery uplands, where nearly all other indications of life have ceased, forms one of the most common of those rural sounds, the entire effect of which is usually so agreeable. "There are few associations of our childhood," it has been recently remarked, "more deep and lasting than those connected with the pursuit and capture of these beautiful creatures, some of which are remarkable for their size, and the rich contrast which they exhibit of velvet black and crimson, with bars of brilliant yellow. This splendid attire, however, saves them not from being rudely handled; and we remember the day when an artificial *bink*, that is, a little box made of clay, with a piece of glass at one end, and a sprinkling of sugar at the other, contained as many captives in proportion to its size as the black hole at Calcutta." *

Although so dissimilar in external aspect, a very close connection in regard to structure can be traced between the hive-bee and the kinds of which we now treat. The respective genera are accordingly placed in juxta-position in systematic arrangements. For a long period these genera, as well as several others, were confounded under the common name of Apis, and it was not till a comparatively recent date, that the humble-bees were separated, and the generic term Bombus applied to them. A different formation of certain parts, entailing a difference in

* Ency. Brit., Art. Entomology.

their modes of life, having been subsequently detected, the humble-bees of this country are now very properly divided into two generic groups, *Bombus* and *Apathus*. They may be distinguished from the hive-bee, and other races bearing affinity to them, by having the simple eyes arranged in a curve, instead of forming a triangle; by having an impression in the shape of a cross on the forehead; the labrum transverse, and two distinct spines at the apex of the posterior tibiæ. More obvious characters are afforded by their large, comparatively rounded, hirsute bodies, generally adorned with bands of light-yellow or red. Upwards of forty different species are described as inhabitants of Britain; but as the three distinct races of females, males, and workers, belonging to the same species, often bear little resemblance to one another, and as the hair or down covering their bodies, often of the gayest colours, changes with age, like the plumage of birds, it is by no means unlikely that individuals of the same family, and differing only in sex or age, have, in some instances, been described as of a different species. Speaking of the *hirsuties*, or hairy covering of this family, and of its liability to change of colour, Kirby remarks,* "An insect recently hatched appears in this respect a different species from the same when it has been long exposed to wind and weather. Thus, for instance, *Apis Muscorum*, which, when fresh from the pupa, is distinguished by a thorax covered with hair of a fine orange colour, and by an abdomen whose coat is a

* Monographia Apum Angliae, i. 207.

rich yellow; when it grows old, especially the male, exchanges these brilliant colours for a cinereous hue, which circumstance misled Fabricius to give it as a distinct species, under the name of *A. Senilis.* But not only yellow and red, but even black and white hairs are apt to change their colours through age. All these circumstances make it a matter of some importance to be able to distinguish a recent insect from one that has been long disclosed. This may often be done by inspecting the state of its wings, for in the latter, especially in males, they are usually lacerate at the apex; the body, too, has frequently a good deal of its hair rubbed off. It will not be without use to know into what the predominant colours fade; yellow will usually first turn pale, and then cinereous; red will turn through tawny to yellow, and sometimes to cinereous; white will turn to pale, and sometimes to tawny; and black will now and then turn white. But this is not all the difficulty with which the describer of the Bombinatrices has to struggle; the males in general resemble the females sufficiently to be known as such; but there are several so unlike them as to be easily mistaken for different species; and I am by no means certain that I have not, in more instances than one, described the sexes under different names. Till all can be traced to their nidi, this is not easily to be avoided."

We shall now proceed to give examples of the two genera Bombus and Apathus.

COMMON HUMBLE BEE.

(BOMBUS TERRESTRIS.)

PLATE XIV.

Apis terrestris, *Linn. Kirby's Monog. Apum*, ii. 350.—*Shaw's general Zool.* vi. 348, Pl. 98.—*Donov. Brit. Ins.* iii. Pl. 88, fig. 1.—A. Audax, *Harris' Expos. of Eng. Ins.* xxxviii. fig. 1. —*Reaumur*, vi. Tab. 3, fig. 1.

IN its present restricted sense the genus Bombus may be briefly characterised by the following definition; body oblong, and very hairy; head narrower than the thorax, usually triangular, the antennæ having thirteen joints in the female, fourteen in the male, geniculated at the second joint; exterior palpi exarticulate, interior two-jointed; ligula three-lobed, the central lobe elongated; labium transverse sublinear; hinder tibiæ provided with a hollow expansion for collecting pollen; claws bifid at the apex.

The species named above is one of the best known, and an account of its habits will convey a pretty accurate notion of the proceedings of the rest, although they vary somewhat in their modes of life. In the female, the head and antennæ are black, the mouth with rufescent hairs; proboscis scarcely longer than the head; thorax black, with a bright-yellow band anteriorly; basal segment of the abdomen black, second yellow, third black, the three posterior ones white; wings light-brown, the thick nervures dark coloured, the finer ones ferruginous; legs black and hairy, the pollen, brush, and spines ferruginous. The male has the thoracic and abdominal bands either

pale-yellow or luteous; the posterior tibiæ rather smooth above, the lateral hairs cinereous; abdomen approaching to globose. Slight varieties are formed by the coloured bands being sometimes of a lighter or a darker hue.

This insect abounds in our fields and gardens, and is almost equally common throughout all Europe. It is distinguished above its congeners for strength and activity. It is one of the earliest insects that appear in the spring, and one of the latest to leave us in autumn. It forms its nest, as is well known, in holes in the ground, sometimes excavated laboriously by its own efforts, sometimes previously formed by other animals and taken possession of by the foundress of the colony. The females of this, as of all the other species, are largest in size, the males next, and the workers smallest. Early in spring, when the willows begin to bloom, the female may be seen traversing the gardens by sun-rise with her usual sonorous booming, and busied in collecting honey and pollen from the catkins. The workers do not appear till a somewhat later period, and the males not till autumn, when the thistles are in blossom, upon the flowers of which they are found in great numbers, and in still greater, if possible, upon seeding leeks and onions, where, on a single flower, may be seen half a dozen at the same moment. At this early period of the year, the female is a solitary being, and her flights are directed in search of a place suitable for a habitation. The females only, of all the former year's colony, have survived the winter,

and now dispersing, each seeks a residence for herself, where she may become the foundress of a new community. Having pitched upon a convenient spot, the laborious insect proceeds to excavate first the passage or gallery, then the nest itself, detaching the soil, as it were, grain by grain; she seizes the molecule with the first pair of legs, transfers it instantly to the second, receives it next with the third, and finally pushes it as far as possible behind her. These excavations, situated often above a foot under the surface, are wholly the work of the solitary female. Sometimes, however, the nest is made close to, or even upon the surface when partially hollow, and covered with dry moss; but this is not the usual mode pursued by this species, and in such localities the colony is far less numerous than when at a greater depth.

Having finished the excavation, and carpeted her new dwelling with soft leaves, &c. the insect proceeds to construct brood cells. The wax of which these are formed is secreted, as in the domestic bee, in certain receptacles placed on each side of the middle process of the abdominal scales, and is extracted by the bee in the form of laminæ, moulded to the shape of the insect's body. Unlike the Queen of the hive bees, the mother-bee of this family possesses these wax-secreting organs as well as the workers, and produces the substance in greater quantity than her progeny.

The interior of the humble-bee nest (Pl. XV.) presents a striking contrast to that of the honey-bee

hive. While the beauty and regularity of the latter are such as to excite the admiration of mankind, the nest of the former offers to the eye of the observer little else than a confused and clumsy mass, consisting, apparently, of mishapen lumps of dirty-coloured wax. Amidst these apparent irregularities, however, we discover a number of egg-shaped bodies of a yellowish colour and of different sizes, some of them being 6 lines deep and 4 wide, and others 4 lines deep and $2\frac{1}{2}$ wide, placed on end, and closely cemented together, the central ones projecting above those which are situated towards the edge of the mass. These ovoidal bodies are cocoons of silk, strong and tenacious in their texture, and coated with wax; they contain the young brood. Several clusters placed near each other form a kind of cake or comb, the upper surface of which, from the projection of the central cells, is convex, and the under, of course, concave. These combs are placed in tiers, one above another, and supported by pillars of wax at the outer edges. There are also found in the nest masses of wax of a roundish and irregular form, about $1\frac{1}{4}$ inch in diameter and $\frac{1}{2}$ inch deep; these also are brood cells but of a peculiar kind, for they contain each six or seven larvæ lying close together, and bedded on a quantity of farina moistened with honey, evidently deposited there for their nourishment, and to which they can have recourse immediately on being hatched. When this is consumed, the workers, aware, it would seem, of the fact, make an opening in the top of the cells, and give from time to time an additional sup-

ply, taking care each time to renew the sealing; and this is continued till their transformation into the nymph state takes place, when the feeding ceases, and the cell is finally closed. And, lastly, we find displayed in different places throughout the nest, and stowed away, as it were, in odd corners, a number of small cups or cells filled with honey. A peculiarity with regard to these deserves notice,—they are never sealed like those of the domestic bee, because they are not designed for winter stores of which they have no need, but for daily use.

The cells being prepared for the reception of the brood, the mother proceeds to lay her eggs. These are not fixed on one end, as is the case with those of the domestic bee, but are huddled together without any order, and to the number often, as already stated, of six or seven. This number is deposited at one time by the mother, who does not quit the cell till she has finished her laying. She has good reasons for so doing;—even while in the act of laying, attempts are eagerly made by the workers to seize and devour the eggs, while she as eagerly and courageously protects them. Sometimes she pursues the marauders to the extremity of the comb, while, in the meantime, others, watching the opportunity, steal upon the cell and carry off the eggs. As soon as she has made her deposit, therefore, she carefully seals up the cell, and takes her station on the cover, frequently wheeling her body round, as if to defend her progeny, and doggedly keeping guard for six or eight hours. If she can withstand their voracity for

that period, success attends her exertions, for it is only in its first stage that the egg is sought after by the workers.

In four or five days the eggs are hatched. The larvæ, which differ from those of the hive-bee in having their sides marked by irregular transverse black spots, feed primarily on the magazines previously deposited beside them, and are afterwards supplied by the workers, till they begin to spin their cocoons. In this operation, each larva separates itself from the group to which it has hitherto been attached, forming a lodgement for itself under the roof of the same roomy apartment where it had lived in society. Males and females are bred in the same cell and fed in the same manner, and the cocoons of both are seen mingled together. It may seem difficult to comprehend how, in a cell of such small dimensions, the larvæ can find room to grow, and separately to spin their cocoons. The fact is, the cells acquire, in the meantime, a great addition in point of dimensions. As the inmates increase in size, the lateral pressure of their bodies bursts the slender walls of the cell, and the workers instantly set about repairing the rent, which they do, not by bringing the edges together, but by placing a large patch upon it, the full extent of the opening, and, of course, augmenting by so much the capacity of the cell. A succession of rents, caused by the growth of each of the larvæ, is followed by a succession of patches and additions, till, at last, the cell is augmented to four or five times its original size; and, as the operators by no means resemble their

fellow workers of the hive in the neatness of their work, the several patches adhering to the outside of the cells contribute much to the rough and clumsy appearance which the interior of the nest exhibits.

In fifteen days the bee arrives at its perfect state; its body has become hardened, and is covered with a greyish down, which, on being exposed to the light, assumes a diversity of colours. It gnaws through its prison-walls, assisted by its fellows; and in a quarter of an hour from the commencement of its exertions, it emerges from its cradle, leaves its nest, and takes its first flight into the fields in search of honey. Its deserted habitation has now the form of a truncated cone, and is made a receptacle for provisions. As her progeny gradually increases in numbers, the mother-bee relaxes in her labours; she leaves to them the lining of the walls and roof of the nest with a thin membrane of wax; and though she occasionally lends her aid in the construction of cells, it is only to give the finishing polish to what the workers have already "rough-hewn."

The inmates of an humble-bee nest are, as has been stated, of three classes: females, males, and workers. The old female, we have said, is alone in spring. In May, the eggs which she has laid, have been hatched, and produce workers only; the females and males of the community do not appear till later, —none sooner than June, and the greatest number in July. The males have the advantage of the hive-drone in point of usefulness to the community; for

though they do not burthen themselves with the task of collecting provisions, they bear their part in secreting wax. Like the hive-drones, they have no sting; but they are exempted from the severe fate of the former, in escaping the cruel massacre to which those are doomed. They are suffered to live, and enjoy the natural term of their existence, which, however, extends not beyond the end of Autumn. On the first approach of cold weather, they exhibit evident symptoms of decreasing activity. On alighting on the flowers of any of the late blossoming plants,—as the sun-flower, thistle, &c.; the intoxicating juices concur with the diminished temperature in rendering them utterly helpless, and incapable of saving themselves from danger, and their languor increases till the severity of the cold benumbs them altogether, and life becomes extinct. The workers are not all neuters. Many of them bred in spring, copulate with the males in June, and lay eggs soon after, but only those of males. These males fecundate those females which are reared towards the end of the season, but which do not begin to lay till the following spring, when they each lay the foundation of a new colony. At the approach of winter, that is, the first winter of their existence, they, the females viz. to the number of 30 or 40 together, make a lodgement in or near the old nest, where they pass the torpid season in safety and quiet, till the return of spring awakes them to life and activity, and natural instinct prompts them to disperse, and seek each a dwelling of her own. The old mother, the

males, and the workers, all perish before the cold season arrives.

M. P. Huber, to whom we are indebted for many of the foregoing facts, relates a very interesting anecdote of the instinctive resourses of this insect. While carrying on an experiment respecting the elaboration of wax, he placed a piece of brood-comb with a dozen bees under a bell glass, taking away from them every particle of wax, and furnishing them with farina only. The comb, from the irregularity of its shape, did not rest steadily on the table; and when the bees mounted on it, to impart the necessary warmth to the brood, its rocking motion seemed to annoy them extremely. They had no wax wherewith to remedy the evil; but their instinct, and their intense affection for their young supplied an ingenious expedient. A few of them mounted the comb, and letting their bodies down towards its lower edge, suspended themselves from it, head downwards, by the hooks of their hinder feet; and with those of the second pair of legs which are very long, laid hold on the table, and thus steadied the mass by the mere force of muscular strength. (Pl. VIII. fig. 4.) In this posture they remained till relieved by others, the mother herself lending her aid; and they continued the painful task for two or three days. In the mean time, some honey with which they had at length been supplied, furnished them with the means of producing wax, with which they immediately set about constructing pillars, having their bases resting on the table, and support-

ing the comb. They were thus relieved from their toil; but it was only for a short period; for the wax getting soon dry, the pillars gave way; and the harassed insects were again subjected to the weary task of propping up the tottering edifice by their bodily exertions, when M. Huber took pity on them, and glued the comb firmly to the table.

LAPIDARY OR RED-TAILED BEE.

(*BOMBUS LAPIDARIUS.*)

PLATE XVI. Figs. 1, 2.

Apis lapidaria, *Linn.*—*Donov.* iii. 97, Pl. 108, fig. 1, and xi. 69, Pl. 385, fig. 1.—*Kirby's Monog. Apum*, ii. 364.—Orange-tailed Bee, *Bingley*, iii. 290.—Ap. audens, *Harris Expos.* 130, Pl. 38, fig. 2; Pl. 40, fig. 12; Pl. 40, fig. 15.—Ap. arbustorum, *Fab.*—A. strenuus, *Harris' Expos.* xxxviii. fig. 5.

THIS handsome species receives its specific name from its habit of forming its nest among loose heaps of stones; occasionally, however, it burrows in the earth like the species last described. The female (fig. 2.) is of considerable size, having nearly the whole body of a deep velvetty black clothed with long soft hairs: mouth fringed with red hairs; thorax entirely black; abdomen with the three last segments red. The wings are shorter than the body, almost clear and transparent, the apex a little obscured, and the nervures black; legs deep black, the hairs of the tarsi reddish. The male (fig. 1.) is of smaller dimensions, having the thorax lemon-yellow behind, black on the middle, and pale yellow in front; the forehead with a patch of lemon-yellow; legs with

rufescent hairs, palest on the thighs; underside of the body flavescent. Varieties occur nearly one half smaller than the ordinary length, which often exceeds ten lines.

This is likewise a common bee, not only in Britain, but in most other parts of Europe. It frequents flowers throughout the summer, and is partial to hilly pastures and imperfectly cultivated places. It stores up honey with great assiduity—*strenuè mellificans,* is Linnæus's expression—and it defends it, as most schoolboys can testify, with no small zeal and pertinacity. Its colonies are not so populous as those of B. terrestris, but they are more so than the associations of B. muscorum. Owing to the great difference in the markings, the male has been mistaken by Fabricius and others for a separate species, which he named B. arbustorum.

MOSS OR CARDER BEE.

(*BOMBUS MUSCORUM.*)

PLATE XVI. Fig. 3.

Apis muscorum, *Linn.*—*Donov.* xi. 70, Pl. 382, fig. 2.—*Kirby's Monog. Ap.* ii. 317.—A. senilis, *Fab.*—A. impavidus, melleus and melinus, *Harris'* *Expos.* Pls. 38 and 40.—The Cording Bee, *Bingley,* iii. 288.

USUALLY rather a smaller insect than either of the preceding, although the females sometimes attain the length of ten lines. The general colour of the whole body is pale yellow, the hirsuties rather long; proboscis the length of the thorax, (it is represented in the accompanying fig. with the parts extended and sepa-

rated,) the latter clothed with reddish yellow or golden coloured hairs; abdomen triangular, the hirsuties fulvous; wings slightly tinged with brown, the nervures black; legs likewise black, the thighs densely bearded with yellow hairs. The abdomen of the male is narrower than that of the female, and has some dark coloured down at the extremity. Varies in size, and in having the hirsuties of the thorax dark brown, or so pale, as to approach cinereous; the latter hue sometimes occasioned by age.

Of frequent occurrence in all the temperate regions of Europe. It is known in Scotland as the *Foggie* or Moss-bee. Its nest is quite upon the surface, and, consisting merely of a little dome of moss, it falls an easy prey to every kind of marauder. The following is Reaumur's account, as abridged by Kirby, of its plan of operations; but he seems either to overlook the fact, that at the usual period of forming the nest, the female is the sole architect and practical builder, or his description applies to the formation of the nest at a more advanced period of the season, after the original one may have been by some means destroyed, and when the population has multiplied. After stating that they cover their dwelling with a thick vault or coping of moss, he continues: "The mode in which they transport the moss they use is singular. When they have discovered a parcel of it conveniently situated, they place themselves upon it with their anus towards the spot to which they mean to convey it. They then take a small portion, and with their maxillæ and forelegs, as it were card and

comb it; when the pieces are sufficiently disentangled, they are placed under the body by the first pair of legs; the intermediate pair receives them and delivers them to the last, which pushes them as far as possible beyond the anus. When by this process the insect has formed behind it a small mass of moss well carded, then either the same or another who takes her turn in the business, pushes it nearer to the nest. Thus small heaps of moss are conveyed to its foot; and in a similar manner they are elevated to its summit, or where they may be most wanted. A file of four or five insects is occupied at the same time in this employment.*

DONOVAN'S HUMBLE-BEE.

(*BOMBUS DONOVANELLUS.*)

PLATE XVII. Fig. 1.

Apis Donovanella, *Kirby's Monog. Ap.* ii. 357, Pl. 18, fig. 6.

THE length of this insect very little exceeds seven lines; the prevailing colour black, all the parts very hirsute; head and antennæ black; the mouth with reddish hairs; thorax black, with a dense patch of lemon-yellow hairs in front in the female, but obscure in the male; abdomen between triangular and globose, the base with a broad light-yellow band, then a black one, the three last segments red; legs black; wings tinged with dusky-brown.

This species is named in honour of the late Mr. Donovan, whose extensive works, containing accurate delineations both of British and foreign insects, as well as of other animals, have tended greatly to

* Reaumur's Mem. tom. vi.

promote the study of natural history in this country. It is rather a scarce insect, and approaches near to B. subinterruptus; but, as Kirby remarks, the wings are darker, the abdomen shorter and wider, with the black band much narrower; the red hairs of the anus of a deeper colour, and occupying three segments.

HARRIS' HUMBLE-BEE.

(*BOMBUS HARRISELLUS.*)

PLATE XVIII. Fig. 1.

Apis Harrisella, *Kirby's Monog. Ap.* ii. 373, Pl. 18, fig. 8, fig. 7.

THIS species differs from all that we have hitherto described, in being wholly deep-black, the mouth alone with a few ferruginous hairs. The wings are slightly tinged with yellowish-brown, becoming somewhat obscure at the apex, the nervures blackish.

Found occasionally in the south of England; the male more frequently than the female.

BOMBUS GRANDIS.

PLATE XVII. Fig. 2.

THIS figure represents the largest species of Bombus hitherto discovered, drawn by Mr. Westwood from a specimen in the collection of the Rev. F. W. Hope. It has not yet been described, and is known only by a figure in Guerin's Iconographie du Règne Animal, Insectes, Pl. 75, fig. 3. The whole upper side is a uniform fulvous colour; the region of the eyes, the mouth, and antennæ, black; the whole of the underside is likewise black, and the legs of the same colour; wings tinged with yellowish-brown; the

nervures black. Length about an inch and a quarter: expansion of the wings two inches and a quarter.

It is a native of Valparaiso.

APATHUS VESTALIS.

PLATE XVIII. Fig. 2.

Apis vestalis, *Kirby's Monog. Ap.* ii. 347, Pl. 18, fig. 4,—fig. 3. —*Donov.* xiii. 65, Pl. 464.—Bombus vestalis, *Stephen's Catal.*—Psithyrus vestalis, *St. Fargeau*, *Curtis.*

THE peculiarities on which this genus is founded, were pointed out, to a certain extent, by Kirby, but he did not avail himself of them to separate the group from the true humble-bees. In fact, there is such a striking general resemblance between the Apathi and Bombi, that such a separation appears at first sight to be doing violence to natural affinity. But the principal mark of distinction, the want of a brush (*corbicula*) for collecting masses of pollen, is a most important one, and might have been expected to influence materially the whole mode of life. There seems now to be no doubt, that the Apathi never attempt to build a nest of any kind, or to make any provision for their young, but deposit their eggs in the nests of other bees, into which they find access apparently without being suspected of any improper design. The larvæ produced by these surreptitious eggs being stronger than the rightful owners, consume the food provided for them. They undergo their various changes in the same appropriated home. This practice is known to prevail among many other kinds of bees, not, however, very closely resembling

humble-bees (such as the genera Coelioxys, Melecta, Epeolus, &c.) which are therefore called *Cuckoo-bees*. The Apathi may be appropriately designated by the name of *False Humble-bees*. A. Campestris, A. Barbutellus, A. Vestalis, and A. Rupestris, are among our indigenous examples; and there are doubtless many foreign kinds, of which we have received as yet no satisfactory account.

The term Psithyrus was formerly proposed for this genus, but that having been previously employed in another branch of Zoology, Mr. Newman has supplanted it by that used above, which signifies, without affection (privative α and $\pi\alpha\theta o\varsigma$ affectio.) The characters may be briefly given as follows: Labium forming an obtuse angle anteriorly; posterior tibiæ convex above, neither provided with an apparatus for carrying pollen, nor with an auricle at the base of the planta; abdomen oblong, the anal segment dilated into an angle on both sides.

A. vestalis is rather a large insect, measuring from seven to nine lines. The female is black and hirsute; the head subglobose; the thorax with a yellow band anteriorly; abdomen oblong, inclining to globose, incurved at the extremity, the third segment yellow at the margin on both sides, the whole of the fourth and the sides of the fifth whitish, the anal one smooth, and curved inwards. In the male, (fig. 2,) the posterior fascia is broad and whitish, the extremity itself with a patch of black hairs; wings a little dusky; the apex and the larger nervures nearly black; legs black.

Found occasionally near London, and in other parts of England, first appearing pretty early in the spring. It is said to fly for the most part near the earth.

APATHUS RUPESTRIS.

PLATE XVIII, Fig. 3.

Apis rupestris, *Fab. Kirby's Monog. Ap.* ii. 369.—Apis lapidaria, *Var. Brunn. Prodrom. Insectol. Sieland*, Pl. 19.—Apis subterranea, *Geoff. Hist. Ins.* 2, Pl. 416, n. 20.

THE resemblance of this false humble-bee to B. lapidarius is so great, that it is not surprising they have been frequently confounded. The present species measures fully an inch in length, so that it must be regarded as the largest of our indigenous bees. The body is entirely black, the three last segments of the abdomen clothed with yellowish-red hairs. The head and thorax are very hirsute, the abdomen likewise very hirsute on the sides, but more sparingly clothed on the back; shape of the abdomen ovate-oblong; legs black and hairy; wings ample, longer than the body, the colour smoke brown, approaching to black, and the substance intermediate between corium and membrane.

Frequent in the vicinity of London, and also in many other parts of England, but seemingly not generally distributed. We have noticed it in Scotland, but only on one or two occasions.

FOREIGN BEES.

Besides the *Apis Mellifica*, or common domestic bee of Europe, and the genera *Bombus* and *Apathus*, or humble-bees in their several species, there are numerous other kinds of the social Apidæ to be met with in different and distant regions of the earth, of which some notice may be acceptable to our readers. We must premise, however, that the present state of our knowledge of this portion of natural history is very imperfect and unsatisfactory, drawn, as it must necessarily be, from the accounts of travellers, to whom it was a subject of very inferior interest, and whose descriptions of the insects are generally so indistinct, that it is nearly impossible to determine to what families they respectively belong. But before proceeding to give some account of the bees domesticated in different parts of the world, which in general are pretty nearly related to the Honey Bee, it may not be improper to make our readers acquainted with a few interesting exotic forms which claim a closer affinity to the tribe last treated of.

The genus Euglossa, to which we shall first advert, has many properties in common with the Humble Bees. As in them the hinder tibiæ terminate in two spines, and the females are provided with a spoon-shaped expansion for collecting honey. They differ from Bombus and Apathus in having the labrum

square, the false proboscis nearly as long as the body, and the labial pulpi terminating in a point formed by the two last joints.* All the species are exotic, and apparently confined to South America. Several of them are nearly glabrous, (such as *E. dentata,* and *cordata,*) in this respect deviating materially from the external aspect usually associated with the peculiar structure which they exhibit.

EUGLOSSA SURINAMENSIS.

PLATE XIX. Fig 1.

Apis Surinamensis, *Linn.*—Abeille a ventre jaune, *De Geer*, tom. iii, Pl. 28, fig. 9.—Centris Surin. *Fab. Drury's Exot. Ins.* Pl. 43, fig. 4.—Euglossa Surin. *Latr. Gen. Crust. et insect. Zool. Humb. et Bomp.* Pl. 17, fig. 12.

THIS species has been long known, as the above synonyms indicate. It is rather a small insect, the accompanying figure representing it a little enlarged. The body is black, and clothed with a short very dense hirsuties; head and antennæ black, the tongue extending backwards as far as the middle of the abdomen; eyes brown; thorax black; the wings tinged with clear brown; nervures black; abdomen with the basal segment black, the remainder ochre-yellow, appearing as if gilded; the black colour on the underside of the abdomen extends to the middle; legs black, the tibiæ and radical joint of the tarsus in the hinder pair broad and flat.

Inhabits Surinam, Xalapa in New Spain, and other parts of South America.

* Cuvier, Regne Anim. v. 357.

EUGLOSSA ANALIS.

PLATE XIX. Fig. 2.

THE figure referred to represents a small and very brilliant Euglossa, which we have the pleasure of figuring and describing for the first time. In length it is not quite half an inch, and the wings expand about three quarters of an inch. The head and thorax on the upper side are punctured, and of an intense rich blue; the clypeus at the sides, labrum and mandibles white; underside of the thorax rich green; the surface of the abdomen is finely and closely punctured, the colour purple, the terminal segments being brilliant golden-green, especially on the underside; the wings are slightly stained with brown; the second submarginal cell receives the first recurrent nerve; the second recurrent nerve being confluent with the nerve which closes the third submarginal cell posteriorly; the legs are rich blue and shining, the anterior tarsi with long white pile; the posterior tibiæ are very broad, compressed and punctured, having an impression on the upper edge in the middle, from which an impressed line extends parallel with the edge nearly to the tip; the basal joint of the tarsi is broadly triangular and compressed.

This beautiful insect is from the collection of the Rev. F. W. Hope, and is a native of Brazil. It is related to the *Cnemidium viride* of Perty (*Del. animal. artic. Braziliæ,* Pl. 28, fig. 9.)

AGLAE CAERULEA.

PLATE XIX. Fig. 3.

Aglaé caerulea, *Encyclop. Methodique.—Griffiths Cuvier, Insecta*, vol. ii. Pl. 107.

THIS group, peculiar, like the former, to South America, was separated from Euglossa by M.M. Lepeletier and Serville. The antennæ are long and filiform, inserted in a frontal cavity, consisting of twelve joints in the female and thirteen in the male; labial palpi four-jointed; ocelli three; scutellum depressed, the sides prolonged behind into two spiniform projections. The species are probably parasitical, for they are destitute of the apparatus requisite for collecting pollen. The species represented may be regarded as the type. It is a large insect compared with the generality of its associates, of a violet blue colour, very glossy, and covered, though not very thickly, with black hairs; antennæ black; sides of the abdomen, which bear tufts of hair, brownish; wings likewise of that colour with a slight golden reflection; labrum and scutellum very glossy.

It is a native of Cayenne.

CENTRIS NOBILIS.

PLATE XX. Fig. 1.

CENTRIS has the antennæ filiform in both sexes, of twelve joints in the female and thirteen in the male; the third joint always slender throughout its whole length but suddenly enlarged at the tip; mandibles with four teeth on the inner edge; maxillary palpi

very slender, and consisting of four joints, which is likewise the case with the labial pair; spines of the hinder legs pectinated on the inner side.

To exemplify this genus we have represented a new and splendid species from the collection of the Rev. F. W. Hope, which, on account of its large size and vivid colours, Mr. Westwood has named *C. nobilis*. It is of an intense black, clothed with very short velvet-like plush; the three terminal segments of the abdomen brick-red, and the wings black, with an exceedingly brilliant purple gloss; the length is about thirteen lines; expanse of the wings nearly two inches; the second submarginal cell receives the first recurrent nerve, and the second recurrent nerve is confluent with the nerve which closes the third submarginal cell; the hind legs are extremely hirsute, with two long and acute tibial calcaria, both denticulated, but one more strongly than the other; the upper lip is triangular; the mandibles with four teeth, the two inferior ones strongest and obtuse; the maxillary palpi short, very slender, and four-jointed.

Locality doubtful; but in all probability South America.

CENTRIS GROSSA.

PLATE XX. Fig. 2.

Apis Grossa, *Drury*.—Centris Grossa, *Drury's Exot. Ins.* (*Westwood's ed.*) i. Pl. 45, fig. 3.

HEAD bluish-black, with a mixture of green; antennæ black; thorax of a dark golden green, inclining to

blue, very glossy, notwithstanding a few scattered black hairs; abdomen nearly of the same brilliant hue as the thorax; the underside with a greater mixture of blue; legs black and hairy; wings brown.

A native of Jamaica; nearly allied to *Centris versicolor* of Fabricius, which also inhabits the west Indian Islands.

XYLOCOPA VIOLACEA.

PLATE XX. Fig. 3.

Fab. Reaumur, Donov. Indian Insects.

THIS genus contains a very conspicuous group of insects, somewhat resembling humble-bees, but their colours are much darker, and never distributed in bands; the body much flatter, and the whole contour different. The wings are usually very dark, and reflect brilliant tints of violet and copper; and although the body is in most cases black, it often presents a fine play of purple or green. The eyes are large, and sometimes approximating behind, but always rather distant from each other; head narrower than the thorax, broad and depressed; proboscis rather short; exterior palpi six-jointed; interior two-jointed; antennæ strongly geniculated; upper wings with three complete cubital cells, the first intersected by a slender transparent line, the second triangular, the third largest, and receiving the two recurrent nervures. Nearly all of them are extra-European and inhabiting the very warmest regions. Among the few exceptions to this, is the species referred to above which occurs in various parts of Europe, and naturalists accordingly have often

had opportunities of observing its habits. The best account is that given by Reaumur, of which we shall therefore introduce an abridgement, premising that the insect is entirely of a black colour, the wings deeply tinted with violet, and the male having a reddish ring at the extremity of the antennæ.

"The mother-bee usually makes her appearance early in the year, as soon as winter is over. She may then be met with in gardens, visiting such walls as are covered with trees trained upon trellis work, in a warm sunny aspect. When once she has begun to make her appearance, she frequently returns, and during a long period; and she may always be known by her size, and her hum, which much resembles that of the *Bombinatrices*. The object of her earlier visits is to fix upon a piece of wood proper for her purposes. She usually selects the putrescent uprights of arbours, espaliers, or the props of vines; but sometimes she will attack garden seats, thick doors, and window shutters; the piece that she chooses is usually cylindrical, and perpendicular to the horizon. Her strong maxillæ are the instruments she employs in boring it; beginning on one side for a little way she points her course obliquely downwards, and then forwards in a direction parallel with its sides, till she has bored a tunnel of from twelve to fifteen inches in length, and seven or eight lines in diameter. A passage is left where she enters or first begins to bore, and another at the other end of the pipe. As the industrious animal proceeds in her employment, she clears away the wood that she detaches, throwing it out upon

the ground, where it appears like a small heap of saw-dust. Thus, we see, she has prepared a long cylinder in the middle of the wood, sheltered from the weather and external injuries, and fit for her purposes. But how is she to divide it into cells? what materials can she employ for making the floors and ceilings of her miniature apartments? Why, truly, God 'doth instruct her to discretion, and doth teach her!' The saw-dust, just mentioned, is at hand, and this supplies her with all that she wants to make this part of her mansion complete. Beginning at the bottom of the cylinder she deposits an egg, and then lays in a store of pollen, mixed with honey, sufficient for the nutriment of the little animal it is to produce. At the height of seven or eight lines, which is the depth of each cell, she next constructs, of particles of the saw-dust glued together, and also to the sides of the tunnel, what may be called an annular stage or scaffolding. When this is sufficiently hardened, its anterior edge affords a support for a second ring of the same materials, and thus the ceiling is gradually formed of these concentric circles, till there remains only a small orifice in its centre; and this is also filled up with a circular mass of agglutinated particles of the saw-dust. This partition exhibits the appearance of as many concentric circles as the animal has made joinings, and is about the thickness of a French crown-piece; it serves for the ceiling of the lower, and the floor of the upper apartment. One cell being completed, she proceeds to another, which she furnishes and finishes in the same manner; and so on till she has divided her whole tunnel into apartments, which are usually about twelve.

The larvæ and pupæ do not differ materially from those of other bees. When the former assumes the pupa it is placed in its cell with the head downwards—a very wise precaution, for thus it is prevented, when it has attained its perfect state, and is eager to emerge into day, from making its way out upwards, and disturbing the tenants of the superincumbent cells, who being of later date each than its neighbour below stairs, are not yet quite ready to go into public."

XYLOCOPA TEREDO.

PLATE XXI. Fig. 1, Male,—Fig. 2, Female.

Xylocopa Teredo, *Linn. Trans.* XIV. p. 314.

FOR a knowledge of the habits and sexual distinctions of this species we are indebted to the assiduous and indefatigable Lansdowne Guilding, whose account was published in the fourteenth volume of the Linnæan Society's Transactions. It does not differ much in its economy from the species last described. It takes up its abode in dead trunks of trees, piercing into the interior in a horizontal direction, and then forming longitudinal excavations. Its little nests are very numerous, and placed without any order. Beginning at the bottom, the female fills each little cell with pollen, mixed with honey, and deposits an egg in it. The larva which proceeds from this egg is apodal, naked, and whitish, much attenuated towards the head, which is very small, and of an ochreous yellow colour; the mandibles rust-red, the spiracles likewise red. The pupa is ochre-yellow, the thorax anteriorly armed with two spines.

The dissimilarity of the sexes is so great, as to

lead us to apprehend that several of the kinds of Xylocopæ, now regarded as distinct species, may ultimately prove identical, when we obtain as correct information regarding them as we possess in the present instance. The male (fig. 1,) is entirely tawny-yellow on the upper side, and blackish beneath; wings rather pale yellow, antennæ yellow on the under side, legs likewise tawny, the hairs of the two anterior pair paler yellow. The female (fig. 2,) is deep black, the wings broad and of a brassy hue, with purple reflections. The difference between the sexes is not confined to colour, but extends likewise to form. The male is comparatively slender, the thorax oblong, and the head small; the female has a very large head, and an orbicular thorax, the whole body appearing short and massive. These differences appear more conspicuous in Mr. Westwood's drawings, from which the accompanying engraving is taken, than in Mr. Guilding's figures; but Mr. Westwood's are carefully drawn from Guilding's own series of specimens, which are now in the possession of the Rev. F. W. Hope, so that no doubt can possibly attach to the identity of the insects. It may be said that the evidence from which they are inferred to be the sexes of one species is not absolutely conclusive, for no one has ever witnessed their union; but Mr. Guilding constantly found both of them in company, frequenting the same holes, the dark individuals being invariably females, and the other males, which affords so strong a presumption in favour of the opinion he formed, that little doubt on the subject can

be reasonably entertained. This dissimilarity of the sexes is important to be noticed, on account of the difficulty of determining such exotic species of Xylocopæ as are closely related to each other. The propriety of giving Xylocopa Moris Fab. as a synonym of the female of the insect in question, or Apis Brasilianorum as that of the male, as Mr. Guilding has done, is extremely questionable. Mr. Westwood, whose opinion is of so much value on a point of this kind, has scarcely a doubt that the Xylocopa Chrysoptera of Latreille (Humboldt's South Amer. Zool. Pl. XXXVIII. fig. 1,) is the female of X. Brasilianorum.

XYLOCOPA CORNIGER.

PLATE XXI. Fig. 3.

THIS figure represents a very large, nondescript, and unique species of Xylocopa, from the collection of the Rev. F. W. Hope. Mr. Westwood, to whom we are indebted for a beautiful drawing of it, proposes to name it X. Corniger, on account of two short strong horns upon the back part of the head, a character which does not occur in any other known species of the genus.

It is entirely black and shining, the upper surface of the thorax and abdomen being entirely destitute of hairs. The front of the head is broad, and bears two oblique elevated shining ridges above the mouth, and between the posterior part of the eyes are two short thick horns. The abdomen is long and depressed, with fascicles of black hairs on the sides and extremity. The wings are black and very glossy, with a

rich violet blue tint at the base, which alters slightly to greenish near the middle, and this is shaded off to coppery brown at the tips.

The locality is unfortunately unknown; it is probably Africa.

XYLOCOPA (*PLATYNOPODA*, *WEST.*) TENUISCAPA.

PLATE XXIII. Fig. 2.

THIS figure represents a species very closely related to *X. latipes*, and the existence of another with greatly dilated tarsi renders it expedient to propose a distinct section or subgenus for their reception, which Mr. Westwood has accordingly done under the above name. In addition to the peculiarity just noted, the males have the eyes approximating at the hinder part of the head. The near resemblance of this insect to X. latipes will at once appear from comparison. (For this purpose X. latipes is figured on the same plate, fig. 1.) The distinctive marks may be embodied in the following short specific character:—*X. tenuiscapa, W.*; black, somewhat shining; the first joint of the antennæ not dilated at the apex, which is scarcely thicker than the base; eyes not widely apart behind; the second, third, and fourth joints of the anterior tarsi with a rather short brush on their inner edge; wings very glossy, violet at the base, and tinged with copper at the tip; length $1\frac{1}{10}$ inch, expansion of the wings $2\frac{1}{2}$ inches.

As this handsome species is now figured for the first time, it will be necessary, for the satisfaction of

entomologists, to describe it more in detail. In its general form it is broad and depressed, the colour shining black, the abdomen being duller than the thorax, the latter clothed in front with short black hairs, and the sides and extremity of the abdomen are fringed with longer hairs of the same colour. The eyes are of a dull white, and approaching each other at the hinder part of the head, but separated by a considerably wider space than those of X. latipes. Antennæ black, the basal joint not dilated as in the species just named; legs black, clothed with long hair, the anterior tarsi of a dirty white colour, the basal joint very thin, flat, and broad, (but not so dilated as in X. latipes,) and furnished, especially on the outer edge, with a thick brush of brown hairs, the terminal joints flat and brown, with a similar brush on the outer margin, the brush on the inner margin of these joints being much shorter and thicker than in X. latipes. The wings are nearly opaque at the base, but become gradually more transparent at the tips; the former portion with an intense violet gloss, which is gradually shaded off to a coppery green.* (In X. latipes the wings have a green gloss at the base, which is shaded off into a purple bronze.) The clypeus is black, with the exception of a very minute pale spot on each side, close to the base of the mandibles.

This species is from India, and the individual figured

* Mr. Westwood is of opinion that the colour of the gloss of the wing affords a very good, although hitherto neglected, specific character in this difficult genus.

is preserved in the collection of the Rev. F. W. Hope. X. latipes is likewise an eastern insect. "According to Mr. Smeathman, these bees are very injurious to wooden houses, the posts of which they bore and perforate in various directions, so as to weaken them very much; the holes they make are half an inch in diameter. Drury hazards the conjecture, that the curiously dilated anterior tarsi, and the long hairs with which they are furnished, appear to be useful to the creature for containing the substance of which these insects compose their nests. This, however, is but mere conjecture, since it is the males only that possess this curious construction, and this sex takes no share in the construction or provisioning of the nest in any species of bees with whose economy we are hitherto acquainted."*

Having given these details respecting foreign species, most of them bearing some affinity to the Bombinatrices, we now return to the kinds more closely related to the Hive-Bee, which alone have been subjected to an assured domestication. In Europe we have two distinct species of domestic honey-bees. Besides the one commonly cultivated, viz., the *Apis mellifica*, which has extended itself over the greater part of the European Continent, is met with even in Barbary, and has now been naturalized in the extensive wastes and prairies of North America,—the *Apis Ligustica* of Spinola, *A. Ligurienne* of Latreille, (See Pl. XXIV.,) is cultivated with success in Italy, and is probably the same

* Drury's Illust., Westwood's ed., vol. ii. p. 98.

species that is found in the Grecian Archipelago. In its physical characters it nearly resembles our own hive-bee; the difference consists in the two first rings of the abdomen, (except at their posterior edge) and the base of the third, being of a pale reddish colour, instead of a deep brown.

The continent of Africa, in all its widely extended regions, seems well stocked with bees, particularly towards the sea-coast. In lower Egypt their cultivation forms the employment of many of the poorer classes during a great part of the year. During the inundation of the Nile, the cultivators, unable to find pasturage for their bee-stocks in the lower province, transport them in boats to upper Egypt, resting occasionally by the way, to allow the industrious insects an opportunity to forage—and thus they reap a double harvest. The insect itself, supposed to be the *A. Fasciata* of Latreille, bears a considerable resemblance to that cultivated in Greece. On the western coast, where it is intersected by the Senegal, separated as this region is from the more northerly parts of Africa by mountains and deserts which form an insuperable barrier to the passage of the inferior classes of animals, we find what we are assured is another species of bees, viz., *A. Adansonii.* It has, however, a very near resemblance to *A. Ligustica;* its difference being in the two first rings of the abdomen, and the anterior half of the third, which are of a pale chestnut colour. In the neighbourhood of the Gambia, a species of small black bees is found in the woods—in all likelihood the same with those

last mentioned; and the town of Vintain, situated on the southern side of the river, is much resorted to by Europeans on account of the great quantities of bees-wax brought thither for sale. It is collected in the woods by the Feloops, a wild and unsociable race of people. The honey they chiefly use themselves in making a strong intoxicating liquor, much the same as the mead which is produced from honey in Britain.* It is said by some writers that the bees along the west coast of Africa are destitute of stings. It was not so found by Park, to whom we are indebted for the above information; and that those farther in the interior, about the 11th deg. of west long. are well provided with this formidable weapon, appears from the following incident, mentioned by the same traveller as having taken place near Doofroo:—"We had no sooner unloaded the asses, than some of the people, being in search of honey, unfortunately disturbed a large swarm of bees. They came out in immense numbers, and attacked men and beasts at the same time. Luckily most of the asses were loose, and galloped up the valley; but the horses and people were very much stung, and obliged to scamper off in all directions. In fact, for half an hour, the bees seemed completely to have put an end to our journey. In the evening, when they became less troublesome, and we could venture to collect our cattle, we found many of them much stung and swelled about the head. Three asses were missing; one died in the evening, and one next morning. Our

* Parks Travels in Africa, vol. i. p. 6.

guide lost his horse, and many of the people were much stung about the hands and face." On the eastern side of the same continent, the bees appear to resemble those of the western coast in their colour and diminutive size, but differ from them in the mode of constructing their nests, which are formed under the surface of the ground, while those of the others are lodged in the hollows of trees. To the southward, and in the Hottentot countries, the insects are found in great numbers; but, as appears from the reports of some late travellers, never build their nests in the trunks of trees; and though they are sometimes found nestling under the surface of the ground, make their dwellings chiefly in the clefts of the rocks; and one large rock in the Cape Colony has so long served as a favourite residence to these insects, as to obtain from the Dutch settlers the name of "Honing Kliss," *i. e. Honey-rock.* The following anecdotes relating to this species are from Burchell's Travels in Africa, (Vol. I. 377, and II. 81):—"My bedding having been left out in the air all day, we found in the evening the mattress taken possession of by a swarm of bees which had taken shelter under it for the night; and as a favour to these industrious creatures, we left them undisturbed. They remained there till the next day at noon, when they departed in quest of some convenient chink in the rocks for their hive. Their manner of swarming appeared to us to differ in nothing from that of the common English bee. The same species, or others of the genus Apis, abounds in every part of this continent

which has come under my observation, and is everywhere eagerly robbed of its honey. None of these nations have the least idea of bringing them under domestic management, but are content to take the honey wherever it is found; and this being done often at an improper season, they make a useless destruction of the larvæ or young bees still in the cells."—"One of the Hottentots observed a number of bees entering a hole in the ground, which had formerly belonged to some animal of the weasel kind. As he made signs for us to come to him, we turned that way, fearing he had met with some accident; and when the people began to unearth the bees, I did not expect that we should escape without being severely stung. But they knew so well how to manage an affair of this kind, that they robbed the poor insects with the greatest ease and safety. Before they commenced digging, a fire was made near the hole, and constantly supplied with damp fuel to produce a cloud of smoke. In this the workman was completely enveloped; so that the bees returning from the fields were prevented from approaching, and those which flew out of the nest were driven by it to a distance. Yet the rest of our party, to avoid their resentment, found it prudent either to ride off, or stand also in the smoke. About three pounds of honey were obtained, which, excepting a small share which I reserved till tea-time, they instantly devoured in the comb; and some of the Hottentots professed to be equally fond of the larvæ. The honey appeared unusually liquid, and nearly as

thin as water, yet it seemed as sweet, and of as delicate a taste as the best honey of England."

"Whilst I was engaged in the chace one day on foot with a Namaqua attendant, he picked up a small stone, looked at it earnestly, then over the plain, and threw it down again. I asked what it was; he said there was the mark of a bee on it; taking it up, I also saw on it a small pointed drop of wax,* which had fallen from a bee in its flight. The Namaqua noticed the direction the point of the drop indicated, and, walking on, he picked up another stone, also with a drop of wax on it, and so on at considerable intervals, till, getting behind a crag, he looked up, and bees were seen flying across the sky, and in and out of a cleft in the face of the rock. Here of course was the honey he was in pursuit of. A dry bush is selected, fire is made, the cliff is ascended, and the nest is robbed in the smoke."†

African travellers give us an amusing account of one of the modes by which the natives in the interior are enabled to discover the spot where the bees have deposited their treasures. They are guided by a small bird (*Cuculus Indicus,* See Plate XXV.) of a brownish-grey colour, well named the *Honey-Guide.* This little creature is very fond of honey and bee-brood; but unable by its own exertions to secure the means of gratifying its taste, it directs the negroes, by a peculiar cry or whistle, to the tree where the bees have taken up their residence, advancing before

* More probably excrement.

† Alexander's Expedition into the Interior of Africa.

them by longer or shorter flights, according to the greater or lesser distance of the object of pursuit. If its followers lag behind, it returns with manifest impatience, and by its redoubled cries appears to chide their delay. As it approaches the tree, its flights become more limited, its whistle is repeated at shorter intervals, and at last, having brought its associates to the desired spot, it hovers over it for a moment, as if to mark it out distinctly, and then quietly takes up a station at a little distance, waiting the result, and expecting its share of the booty, which it never fails to obtain.

In the island of Madagascar, and the Mauritius, is to be found the *Apis Unicolor* of Latreille, of a bright shining black, without spots or coloured bands. Its honey, as appears from a specimen brought home by the master of a French vessel, is highly aromatic, and is, while in the cells, or when recently abstracted, of a green colour, but becomes afterwards of a reddish yellow. In these islands, the bee is domesticated; and a French Naturalist, M. de Lanux, has published a memoir on the form of the Madagascar hives—a circumstance which naturally leads to the supposition, that the inhabitants pay considerable attention to the cultivation of this insect.*

Knox, in his history of Ceylon, enumerates three kinds of bees found in that island; the first of which bears a close resemblance to the European insect, though, it would seem, by no means so irritable, and which, like those near the Cape of Good Hope, builds

* Latreille, Obs. de Zool. au voyage de Humboldt.

in hollow trees, and also in holes in the ground which have been made by some burrowing animals. The natives, to obtain the honey, have merely to blow into those holes, upon which the bees instantly decamp without resistance, and the plunderers, without making use of any defensive covering, pull out the combs with their hands, and deposit them in vessels brought for that purpose. It is probable from this account of the facility with which this species is deprived of its stores, and the fearlessness of the plunderers, that, like others to be afterwards mentioned, it has no sting. A second species found here is of a larger size and brighter colour than our domestic bee. These build their nests on the branches of trees, and generally at a great height. At a certain period of the year the inhabitants of the towns go out in a body to despoil them, and return laden with the booty. The third species is a remarkably small bee, not larger than a common fly, and of a blackish hue. Their honey is not generally much regarded; but the children sometimes amuse themselves by cutting a hole in the trunk of the tree where it is deposited, and carrying it off. Nay, Knox tells us that the inhabitants not only devour the honey, but have a strong taste—akin to that of the Hottentots who feed on the larvæ—for the bees themselves; and that when they discover a swarm on an inaccessible branch of a tree, they stupify them with the smoke of torches, causing them to drop on the ground, when they gather them and carry them home, "boiling and eating them, and esteeming them excellent food."

The *Apis Indica* of Fabricius, found in Pondicherry and Bengal, is of a smaller size than our domestic bee, if we may judge from the dimensions of the cells, which are only about three-fifths of the size of the European. This is probably the small species found in Ceylon. Latreille gives a figure and description of a piece of comb supposed to belong to this species; and taking into account the smallness of the cells, and the consequently greater number in a comb of the same area with one from our hives, he concludes the population of the Indian hive to consist of not less than 80,000 insects. Besides the *Apis Indica*, the naturalist just mentioned notices two other species met with in that region, one of which is one-third longer and stronger than the European race. This may be the same species with the second class described by Knox, as inhabiting Ceylon. The honey cells are much more capacious, and the produce considerably more abundant than from the last mentioned Indian species.

Honey-bees abound also in the whole of the Eastern Archipelago; but we have no certain account of their distinctive characters. We only know that they generally build on the boughs of trees, and that they are never domesticated or collected into hives. In fact, no attention is paid to them, farther than what is requisite to obtain their wax. This, we are told,* is an article of considerable importance in all the eastern islands, from whence it is exported in large oblong cakes to China, Bengal, and other parts of

* Marsden's Sumatra, p. 175.

the continent. Their honey is much inferior to that of Europe, as might be expected from the nature of the vegetation. The honey of the *Apis Peronii,* however, found in the island of Timor, may be considered an exception to this. For our knowledge of it we are indebted to M. Peron, the intrepid French navigator, who describes it as having a yellowish tinge, more liquid than ours, and of an exquisite flavour. It is called by the natives *Bee-sugar.* The distinctive characters of the insect itself consist in the two first rings of the abdomen (with the exception of their posterior edges,) the base of the third, and the greater part of the breast, being of a reddish yellow, and the superior wings of a brownish hue. It appears from recent accounts, that in the distant regions of New South Wales and Van Dieman's Land, besides the indigenous insect, the Bee of Europe has obtained a firm footing, and already rivals the prolific race of South Carolina. The following account is from a periodical of extensive circulation and great utility.*

"The native bee is without a sting, and is not much larger than a common house-fly. It produces abundance of honey and wax, but has not yet been subjected to cultivation; and from its small size, and its building on very high trees, probably never will be so. The European Bee has been oftener than once introduced into Sydney, but without success; the swarms having always left the hives for the woods. A hive was carried to Van Dieman's Land,

* Loudon's Gardener's Magazine, for Dec. 1835.

in the autumn of the year 1830, by Dr. T. B. Wilson, at the suggestion of his friend Mr. R. Gunter of Earl's Court, brought from London in a wire case. It arrived in safety, and the bees swarmed several times the first year; and in the *True Colonist* (a Hobart-Town newspaper) of February 14th 1835, it is stated that a hive descended from Dr. Wilson's, belonging to a gentleman in the neighbourhood of Hobart-Town, had already swarmed eighteen times!"

Major Mitchell states, in his recently published account of his expedition into the interior of Australia, that he sometimes met with bees in great plenty, and some of them were not a little curious in their habits. Although his rifle was in frequent use, he one day found that a quantity of wax and honey had been deposited in the barrel, and also in the hollow part of the ramrod! He had previously noticed a bee occasionally entering the barrel, and it now appeared that wax and honey had been lodged immediately above the charge to the depth of about two inches. The bee which he most frequently observed about his tent, and which was probably the species that selected this perilous depository, was as large as the English bee, and had a sting. "We were now," he says, in another part of his interesting work, "in a 'land flowing with milk and honey;' for the natives with their new tomahawks extracted it in abundance from the hollow branches of the trees, and it seemed that, in the season, they could find it almost everywhere. To such inexpert clowns, as they probably

thought us, the honey and the bees were inaccessible, and indeed invisible, save only when the natives cut it out and brought it to us in little sheets of bark, thus displaying a degree of ingenuity and skill in supplying their wants, which we, with all our science, could not hope to attain. They would catch one of the bees and attach to it, with some rosin or gum, the light down of the swan or owl; thus laden, the bee would make for the branch of some lofty tree, and so betray its home of sweets to its keen-eyed pursuers, whose bee-chase presented indeed a laughable scene."*

In the Western Hemisphere we find the honey-bee in as great variety and abundance as in the Eastern World. In the United States of America, and stretching as far to the westward, as 95 deg. W. long. the domestic bee of Europe has been naturalized, and appears to prosper amazingly, in the new countries continually opening to civilization in that region. Little more than thirty years ago, according to Warden, it was not found to the westward of the Mississippi; but is now spreading over the extensive prairies on the western banks of the Missouri. In these regions, bee-hunting, or *bee-liming*, as it is there called, is a very general occupation; and various modes are described by travellers of obtaining the fruit of the insects' labour. Knowing that in the breeding season, the bees resort much to springs of water in the woods, the hunter places on a flat stone

* Vol. i. p. 171.

a small quantity of honey-comb, and draws round it a circle of white paint. The bee, on approaching the honey, is necessitated generally to cross the circular line, and, of course, its body becomes bedaubed with the colouring matter, and the direction of its route when flying is thereby easily ascertained. The stratagem is repeated at some distance to the right or left of the first station, and the direction of the flight again marked. As the bee always flies in a direct line to her nest, it will be found where the two lines of flight intersect each other. Another mode consists in placing at the favourite resorts of the bees, a piece of reed or tube of some kind, having one of its ends closed up: Into this they are enticed by the smell of a little honey, previously deposited within. The hunter, when a sufficient number has entered, seizes the reed, and claps his thumb on the open end. He then allows one of the captives to escape, and follows the direction in which it flies; when it is out of sight, he releases another, and another in succession, continuing the pursuit till, by the aid of these guides, he reaches the prize.

The bee in North America has to encounter, amongst the feathered tribe, an enemy still more formidable than the honey-hunter. This is the King-bird, or Tyrant Flycatcher, (Muscicapa Tyrannus, Pl. XXVI.) found in both the southern and northern states of the Union, and which, according to Mr. Hector St. John, is so fell an enemy to the honey-gathering tribes, that upon dissecting one which he had shot, he took from its crop as many as 171

apparently dead bees.* "During the breeding season," says Wilson in his American Ornithology, "his extreme affection for his mate, and for his nest and young, makes him suspicious of every bird that happens to pass near his residence, so that he attacks without discrimination every intruder. But he has a worse habit than this, and much more obnoxious to the husbandman, and often more fatal to himself. He loves not the *honey*, but the *bees;* and, it must be confessed, is frequently on the look-out for these industrious little insects. He plants himself on a post of the fence, or on a small tree in the garden, not far from the hives; and from thence sallies on them as they pass and repass, making great havoc among their numbers." The ravages of this little tyrant are not confined to the bee species; he is to be seen often "in pasture fields, taking his stand on the top of rank weeds near the cattle, and making occasional sweeps after passing insects, particularly the large black gad-fly. His eye moves restlessly around him, traces the flight of an insect for a moment or two, then that of a second, and even a third, until he perceives one to his liking, when with a shrill sweep he pursues, seizes it, and returns to the same spot to look out for more. This habit is so conspicuous, when he is watching the bee-hives, that several intelligent farmers of my acquaintance

* Mr. St. John laid these dead bees on a blanket in the sun, and, *mirabile dictu!* out of the 171, no fewer than 54 returned to life, licked themselves clean, and joyfully went back to their hives.

are of opinion, that he picks out only the drones, and never injures the working-bees. Be that as it may, he certainly gives a preference to one bee, and one species of insect over another."

Advancing southwards, we fall in with the bees of Carolina, Florida, Louisiana, &c. If Latreille be correct—and we are disposed to think he is—these are still of the European species; for he tells us, that they extend from the northern States as far south as the Antilles. In the rich provinces above named, bees are reported to increase with such rapidity, that nothing but the most satisfactory proofs can entitle the report to credit. A striking instance of this rapid increase is given in Feburier's Treatise on Bees. M. Bozc, the French Consul in Carolina, walking one morning in the woods adjoining his house, found a swarm of bees which the negroes had just deprived of its honey and wax. He succeeded in getting it to enter his hat, brought it home, and put it into a hive. By the end of autumn, it had yielded *eleven swarms*, and these had, one with another, produced as many more; so that at the end of the year he had *twenty-two!* besides losing several for want of hives to lodge them.

In the island of Cuba, their multiplication is said to be still more extraordinary; so much so, that though they have not existed there above seventy years, thousands of swarms perish yearly from not finding suitable places to settle in. They were introduced into this island in 1763, by some emigrants from Florida; and such was the rapidity with which

they multiplied in the hollows of the old trees, that there was soon sufficient wax for the annual consumption. In 1777, fourteen years from their introduction, 715,000 lbs. weight of wax were exported from the Havannah, of a quality equal to the wax of Venice. Including the contraband, Cuba exported in 1803, 42,670 arobas of wax, equal to more than 1900 tons. The price was then from twenty to twenty-one piastres per aroba; but the average price in time of peace is only fifteen piastres, or £3, 2s. 6d. sterling. A small part of this wax is produced by the wild bees of the genus *Trigones*, which occupy the trunks of the *Cedrela odorata*; but the principal part is the produce of the common honey-bee,* originally imported from the old world to America —extended to the Southern States, and finally transferred to Cuba by the settlers from Florida.†

In Jamaica, bees are cultivated to some extent,

* Edinburgh Encyclop. article CUBA.

† M. Feburier states, in a note, that M. Michaux, a French botanist, had been informed by the natives of Florida, that bees formerly abounded in that province; but that in one year they had almost all emigrated to Cuba, which is distant twenty-five leagues. Upon this, M. Feburier remarks:—"As that island is covered with orange and lemon trees, the fragrance of the blossoms must have been wafted to Florida, and have attracted the bees; a strong evidence of the acuteness of their sense of smell." We should say, that their strength of wing must have equalled their sense of smell. But the truth is, M. Michaux had been misinformed; for it is a well known fact, that, as we have already stated, when the British obtained possession of Florida, at the peace in 1763, many of the settlers removed to Cuba, and carried their bees along with them.

occasionally by the planters, but more generally by the negroes and people of colour. The honey is dark-coloured, and of a flavour hardly so agreeable as our own. The hives they use are small square boxes of one story. In size and colour the Jamaica bee so strongly resembles the European, as to suggest the probability that it is the same. The only circumstance known to us that raises any doubt of this identity is, that though it possesses a sting, it seldom uses it, and is apparently of a much less irritable temper than ours. As a proof of this greater gentleness, the apiary is, in many cases, situated directly in front of the dwelling-house; and an instance has come to our knowledge of one consisting of not fewer than fifty hives, belonging to a gentleman in the neighbourhood of Savannah-la-Mar, ranged close by the door, and under the front windows. Were the exotic insect as testy as ours, visiters would require some nerve to face coolly so formidable an outpost. The same gentleman has on his estate a row of log-wood trees, the blossoms of which are much resorted to by the bees. Whether there is any species of the insect in this island without stings, we have not been able to ascertain precisely; it seems probable, however, there is not. A resident medical gentleman, to whom the query was put, had never heard of such; and an intelligent negro, who kept a large stock of hives, when asked whether the Jamaica bees had stings, seemed surprised at the question, and answered: "Hey! hab tings? dem ting too trong! dem hab big big ting." The same negro observed that he

had often seen "the leetle chaps collaring the big chaps;" evidently alluding to the massacre of the drones by the working-bees.*

The bees of Guadaloupe are decidedly of a different character from the European, and are probably of the genus *Melipona*. This constitutes, according to the system of Illiger and Latreille, a genus distinct from the genus *Apis* properly so called. In this last, the first articulation of the hinder *tarsi* is *square-shaped,* while in those of the other it is *triangular*. From some minute variation of anatomical structure, a portion of the genus Melipona has been formed into a distinct one, under the denomination of *Trigones*. Latreille specifies the *mandibles* as a distinctive character, and classes under the genus Trigones those whose mandibles are toothed, and under that of Melipona, such as have these organs smooth. Their habits also differ; the former building their nest in the open air, suspended from the branches of trees; the latter constructing their

* Since writing the above, the author has received a swarm of Bees from Jamaica, which unfortunately died on the passage. Upon the most minute examination, no difference could be perceived between these strangers and our own home-bred insects, either in the class of Workers or Males; the Queen could not be found. It must be observed, however, that besides this, which we consider identical with the domestic bee of Northern Europe, there is another species cultivated in Jamaica of a small black kind, of the habits of which we are not aware. In one of the combs of the above imported hive, was found the larva represented in Pl. VIII. with the moth into which it was metamorphosed.

habitations in the cavities of the trunks. The bees of Guadaloupe, however, are sometimes found making their dwellings in clefts of the rocks, as well as in the hollows of trees. Their honey is deposited in clusters of cells, or rather cups, which are of the size and shape of pigeon-eggs; and the wax of which they are formed, is of a deep violet colour, and of so soft a consistence, as materially to diminish its utility. The insect itself is distinguished by its diminutive size, its jet-black colour, and its want of a sting.

The bees of Guiana are generally small, and of a deep black colour like those of Guadaloupe, but armed with a powerful sting. Labat,* however, speaks of a species which have no sting, or one so feeble, that it cannot pierce the skin; and states, that the natives handle them without dread, and without any other inconvenience than a slight tickling. There is a species noticed by Stedman, which builds its nest in the roofs of houses, and is said to attack strangers with the greatest fury, while it does not at all molest the regular occupiers of the habitation where it has established its residence. Another species takes up its abode in the trunks of decayed trees; and if the hollow space is too large for their purpose, they contract it by raising above a kind of waxen dome. Their honey is of the colour of amber, and of an agreeable flavour, but becomes quickly acid. The wax is like that of Guadaloupe, of a dark violet colour, never hardens, and cannot be

* Voyage du Chevalier des Marchais a Cayenne, vol. iii. 253.

blanched. The species named Trigonis Amalthea, (Pl. XXVII. fig. 1.) is also found here. It constructs its nest of a form somewhat resembling a Bagpipe, eight or ten inches in diameter, and eighteen or twenty inches in length, towards the top of a tree of moderate height. (Pl. XXVII.) Within are found large cells filled with a fine reddish-coloured honey. The nest which, on a superficial view, might be mistaken for a mass of coarse earth applied when moist against the tree, cannot be procured until the tree is cut down, when the natives, after using the honey, and making a kind of mead, convert the wax into matches.

In Brazil, there are many species of bees described by travellers,—doubtless including in the number those last noticed as inhabiting Guiana. One or two, however, may be mentioned, which differ in some degree from those alluded to. The first is a species surpassing all the others in size, without a sting, and building in the hollows of trees. Another is described as of a yellowish hue, and of a small size, and having their nests suspended from the branches, sometimes half an ell in length. Koster* notices a species inhabiting the trunks of trees, of a black colour, and smaller than the European; their sting not formidable. The natives of Pernambuco preserve them in a part of the trunk of the tree in which they had been originally found. Their honey is very liquid, and is used as medicine rather than as food; for the small quantities obtained render the

* Travels in Brazil, by Henry Koster, in 1810.

demand for it by medical men fully equal to the supply. Another species have their nests in the ground, enveloped like a sugar-loaf in a wrapper formed of a kind of matted fog. This is perhaps the insect met with by Humboldt, while exploring the Silla mountain in the province of Caraccas. It is described as a little smaller than the honey-bee of Europe, and as making its nest in the ground. It seldom flies, moves slowly, and is not apt to use its sting. Amongst the flowers in these regions to which the bees resort, is one which grows on the Tapurriba tree, and which communicates to the honey a peculiar bitterness.

In Paraguay, several species of bees are enumerated by Don Felix d'Azara, the largest of which he describes as more than double the size of the bee of Old Spain; and the smallest as less than a fourth of the size. Few of them, it is said, have stings; but we are disposed to think, with Latreille, that on this part of the organization of exotic bees generally, our information is of doubtful accuracy; and suspect that many of the species which are said to be without stings, do in fact possess the organ, though often a feeble one, but are not readily provoked to use it. The honey of the large bee described by Azara is not considered good; that of another species produces intoxication; and that of a third causes violent pains and convulsions which continue for thirty hours, without, however, leaving behind any farther bad consequences. The country people readily detect this unwholesome kind of honey, although the taste is as

agreeable as that of the others, and the colour the same. Like the generality of the Melipona tribe, some species deposit their honey not in combs, but in small waxen vessels or cups, resembling, from the description, those constructed by the humble bees of Europe, and about half an inch in diameter. The native Indians use it much as food, and after subjecting it to the process of fermentation, procure from it an intoxicating drink. The wax is of a deeper yellow, and of a softer consistence than ours. It is never whitened, but used in its rude state for lighting the country churches. It is found in such abundance in the woods that the inhabitants of St. Jago del Estero collect yearly in their neighbourhood not less than 14,000 lbs. weight.

It may be noticed here that the inhabitants of Paraguay find a species of wax on the branches of the *Guabirami*. This is a shrub two or three feet high, which produces one of the finest fruits in the country. The wax forms the nests of some small insects, constructed on the branches of the plant; and these tiny dwelling-places are in shape and size like so many pearls, glued together in strings or clusters. The substance itself is much superior to the wax of any of the bees above described as inhabiting the province, both in solidity and whiteness.

One other species is mentioned by Azara as found in Paraguay—and is probably identical with one found in Brazil—which suspends its nest from the branches of trees. It is about two feet in dia-

meter, and formed of a strong hard clay, having its crust or shell of about four inches in thickness. On breaking up one of these nests—an operation which required the aid of a hatchet—it was found composed of combs of wax filled with fine honey. The bee is blackish in colour, not so taper in its shape as the European insect, but nearly of the same size; less irritable, but possessed of a sting.

The most remarkable entomological fact stated by this writer, is the existence in Brazil and Paraguay of a *honey gathering Wasp!* When the statement appeared, it was supposed by Latreille and others, that, not being much versed in entomology, Azara had mistaken for an individual of the wasp family what was in reality one of the Melipona or Trigonis genus, common in South America. More recently, however, the researches of M. de St. Hilaire have confirmed the accuracy of the Spaniard; and it seems now an established fact that the insect provincially named *Lecheguana*, belonging to the genus *Vespa* (*Polistes* of Latreille), produces honey of a very excellent kind, which it stores up in cells for use during the season of the repose of vegetable life, and which differs from that produced by the bees only in being wholly and completely soluble in alcohol, leaving no residue; whereas bee-honey, when subjected to the same chemical process, deposits a crystallized saccharine matter. A figure of the nest constructed by this insect is given in Pl. XXVIII. It is formed of the same materials, and is of similar architecture with that of the European Wasp, viz. of woody fibres re-

duced to a pulp or paste before being used, and is of a conical shape. The insect produces no wax.

We shall conclude this imperfect notice of Foreign Bees with some account of those of Mexico, concerning which more is known than of any others out of Europe. Great attention is paid to them by the Mexicans, not so much on account of their honey, although remarkably rich and delicate, as for the sake of the wax, of which great quantities are consumed in the ceremonies of the Roman Catholic worship. In the peninsula of Yucatan, there are colonies of them domesticated, consisting of five or six hundred hives. Many interesting particulars of their natural history have been furnished by Hernandez in his account of New Spain; and subsequently by our countrymen Captains Beechey and Hall, particularly by the first named officer, who has gone into a minuteness of detail, which would have done credit to one who had made the subject of bees his exclusive study. Hernandez describes several kinds of the insect in Mexico :—one resembling the European, and which produces a honey like our own. It is domesticated by the Indians, who lodge the swarms, he says, in the hollows of trees. A second species is noticed by the same Author, as smaller than ours—so much smaller as to resemble "winged ants,"—and as without stings. They build their nests, which are composed of several layers, probably resembling those of wasps, in the rocks, and also suspend them on trees, particularly the oak. Their honey is dark coloured and high

flavoured. The cells are of smaller dimensions than those of the domestic bee; and it is probable, though not so stated, contain only brood; the honey being found in small cups or sacklets. The larvæ, it appears, are esteemed a delicacy; for the historian tells us, that "when roasted and seasoned with salt," they have the taste and flavour of sweet almonds. This species collect their honey stores, and live much in the same way with the honey-bees of Europe. Other small stingless bees are mentioned, which establish themselves under ground, in nests of a globular shape, but of very coarse workmanship; their honey, too, is inferior, and is never used but in default of better. We have given a figure of a Mexican Bee-Nest, constructed by insects of the genus Trigones, copied from Latreille, (Pl. XXVII.)

It is probably of the species first mentioned by Hernandez, that Captains Beechey and Hall have given us the details. In domesticating their bees, the Mexicans lodge them in hives formed of short logs of wood, from 2 to 3 feet long, hollowed out about 5 inches in diameter, having the ends filled with clay, or wooden doors removeable at pleasure; and a hole for entrance bored on one side, about halfway between the ends. They are suspended in a horizontal position from the branches of trees, or from the cottage eaves.* The hive which Captain Hall examined was made of earthen ware, ornamented with raised figures and circular rings, and was hung in the virandah of a dwelling house. The

* A hive of this kind was sent to the celebrated Huber.

interior of a hive presents, like that of the humble-bee in our own country, a confused and irregular appearance. The combs, which have but one series of cells, are placed, some in a vertical position, and others horizontal—the latter, superior to the other in regularity of form, and of distance from one another. They are grouped together in an oval mass, and occupy nearly half of the internal space, while the other half is stored with the honey cups. The cells which are destined solely for the rearing of the brood are, like ours, hexangular, though the angles are not so sharply defined, nor is the mouth of the cell strengthened by an additional ring of wax. The diameter is the same with that of ours, but the depth less by one-fifth. It is singular that the young bees are found in the cells with their hinder parts directed towards the mouth ; in being hatched, they will of course, make their exit through the bottom, not having the impediment to encounter there which would obstruct the issue of the European bee. The honey, as has been stated, is deposited in small globular bags, hung round the sides of the hive, or placed at the bottom ; some of these receptacles are more than $1\frac{1}{2}$ inch in diameter ; and in many instances are so connected together that, as in the case of cells of common honey combs, one side serves for two cups, thus combining economy and strength. And these magazines of honey being altogether apart from the brood-combs, and noways connected with them, great facility is afforded in depriving the bees of their stores. The honey is

thin in consistence, but of a very agreeable flavour, and gives out a rich aromatic perfume. The wax is coarse, and of a brownish yellow; propolis does not appear to be used.

The Mexican Bee is smaller by one-fifth than the European, and exhibits that difference in the anatomical structure of the posterior tarsi, already noticed, (page 290) and also in the cubital cells of the upper wings, which has been thought a sufficient reason for regarding the Mexican species—and indeed the South American species generally—as distinct from that of Europe, and to which has been given the denomination Melipona or Trigona. Many of these species are, as we have seen, described as having no stings, or at least so feeble a weapon as to produce no sensible injury, and from this circumstance they are known in the Spanish Colonies by the name of *Angelitos*, or little angels. The population of a hive is generally under a 1000. Like their congeners in Europe, they have enemies to guard against; and the Black Ants occasionally put their vigilance and prowess to the proof, sometimes successfully, but more frequently coming off with the worst. One of the community, accordingly, is constantly stationed as a sentinel at the mouth of the hive—keeping her post unrelieved for a whole day; and as the entrance is wide enough only for the admission of one bee at a time, the sentinel has to withdraw into a small cavity formed within the threshold, as often as a bee enters or leaves the hive. Captain Hall remarks

that "the office is no sinecure." Fortunately for the insect on duty, the population is small; were it equal to that of a European hive, the task would be harder by twenty-fold. Like the domestic bee, they are fond of keeping their premises clear of all extraneous and offensive matter. A little paint was dropped at the entrance of a hive; the sentinel carefully examined it, seemed to dislike it, and retreated into the hive. In a few seconds it returned with a troop of companions, each loaded with a portion of wax,—probably a scale in a half liquid state; —this they deposited on the soiled spot, repeating the operation till it was entirely covered, and the nuisance abated. (The interior of the hive of this bee is represented on Pl. XXII.)

We omitted to notice in their proper places, while enumerating the enemies of Exotic Bees, the Ratel and the European Bee-Eater, represented in Plates XXIX and XXX. *The Ratel* (*Viverra mellivora*, (M. *rattellus* of Fred. Cuv.) is an almost inseparable companion of the Honey-Guide, *(Indicator major)* in its exploratory excursions. It is an animal found near the Cape of Good Hope, and assisted by the above-named bird, this creature discovers and successfully attacks the bees in their subterraneous retreats; and after having appropriated the honied stores as its own peculiar prize, leaves to its assistant the combs filled with brood, which is said to be the part of the plunder most valued by the bird. Both of the plunderers are protected from the stings of

the irritated insects by a peculiarly tough skin.* The European Bee-Eater *(Merops apiaster)* is an elegant bird, and clothed in brilliant colours, but with a stridulous and somewhat disagreeable cry. It feeds on insects, especially bees, wasps, hornets, &c., and also on the smaller tribes of gnats and flies. It inhabits the warmer parts of Europe, South Africa, and is seldom met with in the northern regions of the globe; while it abounds in Southern Russia, particularly about the rivers Don and Wolga, whose banks are sometimes perforated to a great extent by their excavations.†

* Kirby's Bridgewater Treatise.

† Edinburgh Encyclopædia, Article Ornithology.

FINIS.

EDINBURGH: PRINTED BY T. CONSTABLE,
PRINTER TO HER MAJESTY.

Honey-bee.

1 Male *2. Queen.* *3. Worker*

Fig. 1

Fig. 2.

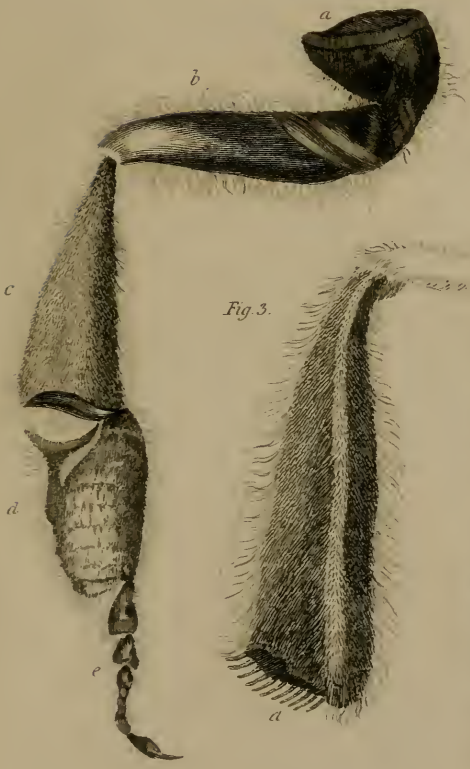


Fig. 3.

Fig. 4.

ANATOMICAL STRUCTURE OF THE BEE.
(Copied from Huber.)

Lizars sc.

Fig. 1

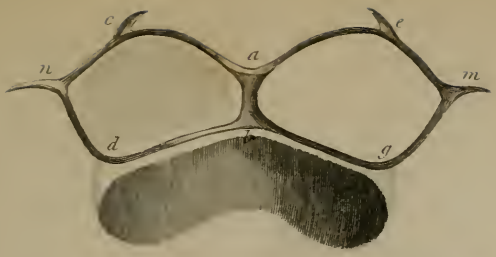


Fig. 2.

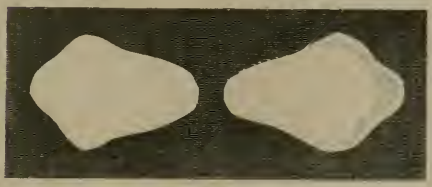
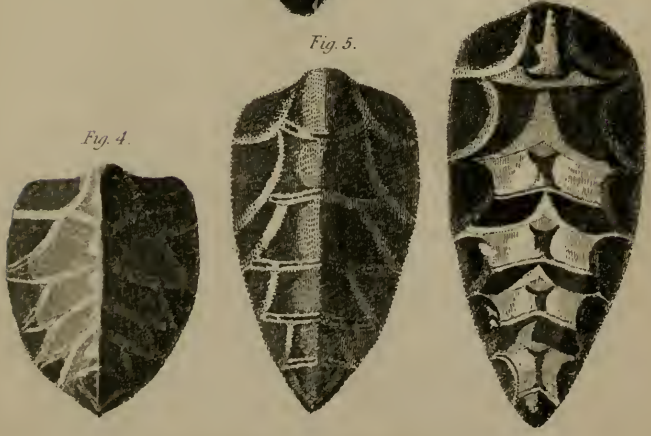


Fig. 3.

Fig. 6.

Fig. 5.

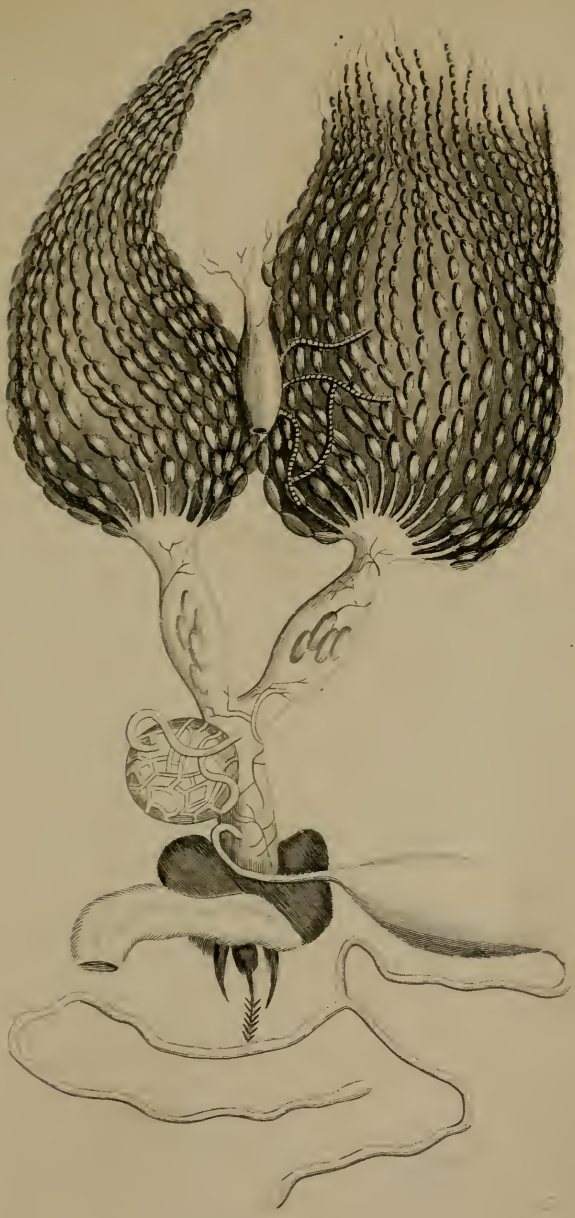
Fig. 4.



Lizars sc

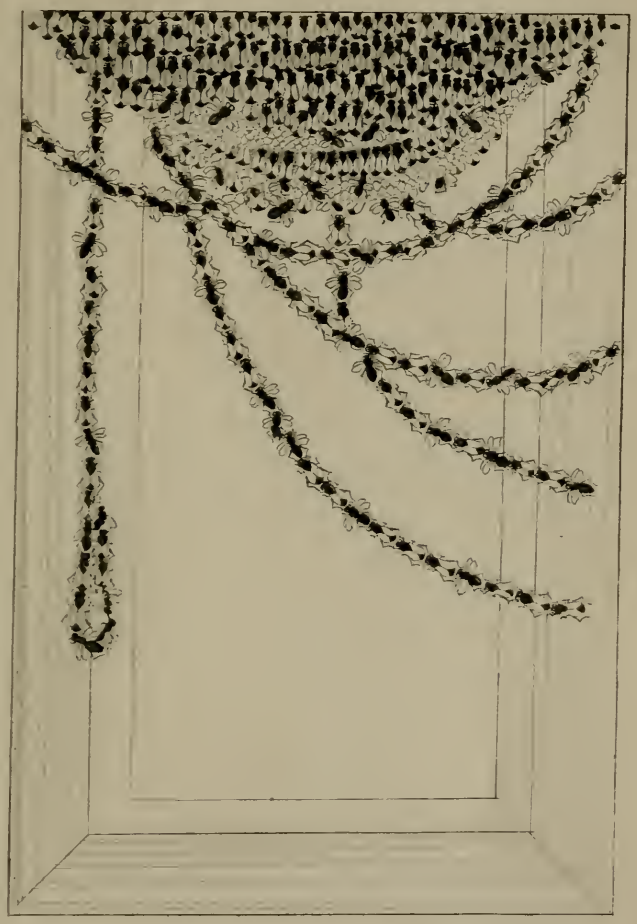
ANATOMICAL STRUCTURE OF THE BEE.

3 A Worker magnified, shewing the position of the scales of wax under the segments of the Abdomen
4. Abdomen of Worker. 5 of Male. 6. of Queen.



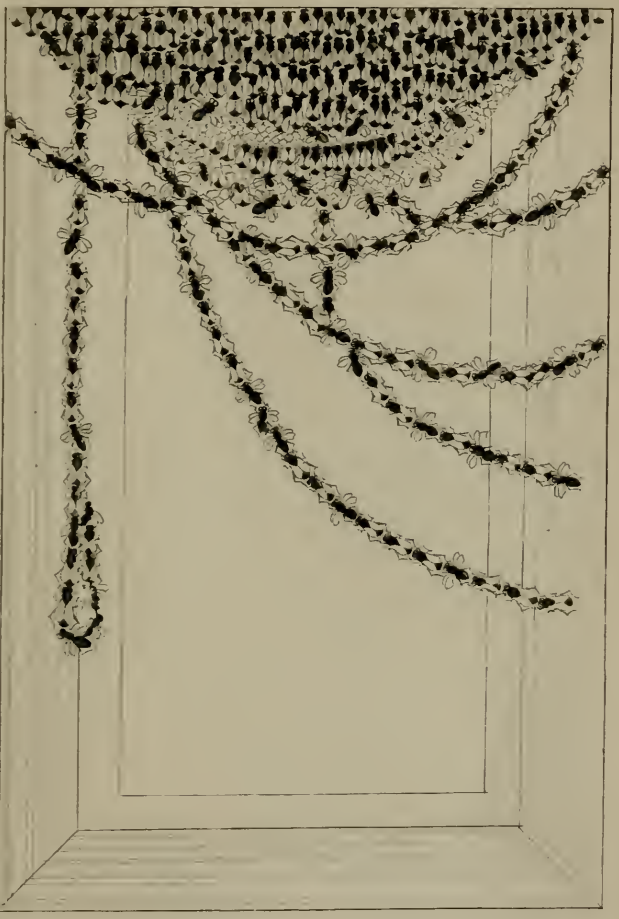
OVARIUM OF THE QUEEN-BEE.

Lizars sc



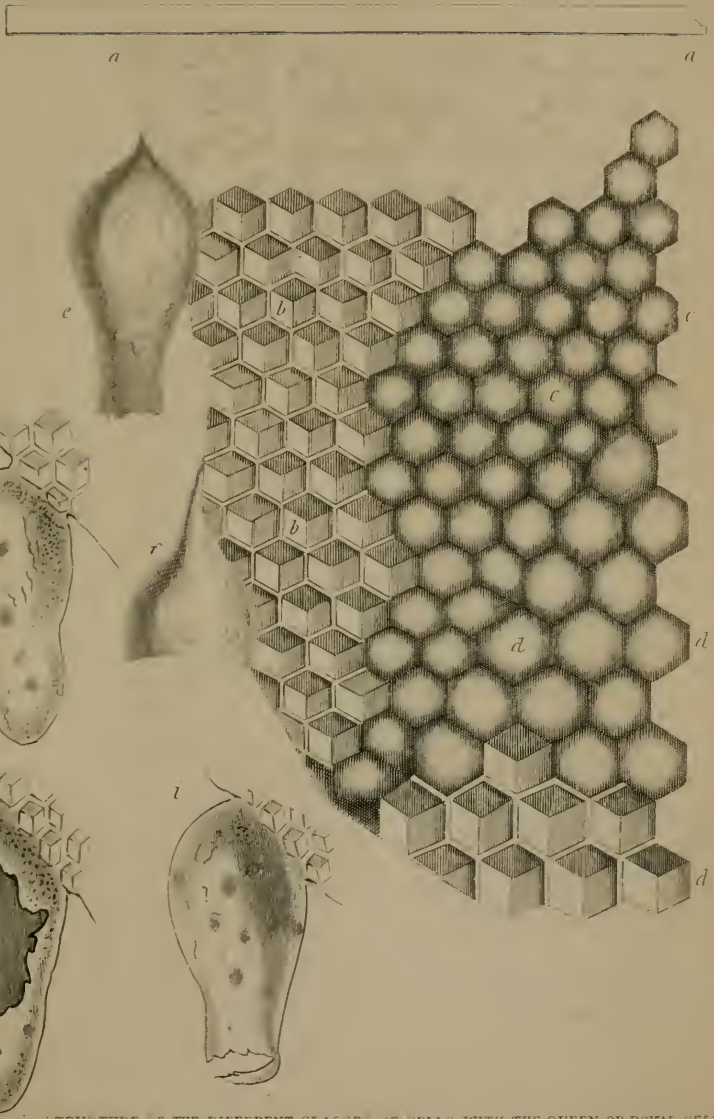
VIEW OF THE INTERIOR OF A HUBER HIVE
Four days after the introduction of a Swarm.

Lizars sc



VIEW OF THE INTERIOR OF A HUBER HIVE
Four days after the introduction of a Swarm.

Lizars sc



STRUCTURE OF THE DIFFERENT CLASSES OF CELLS WITH THE QUEEN OR ROYAL CELL

W. D. del.

Lizars sc.

Stewart delt

Lizars sc

BEE'S SWARMING.

Fig. 1

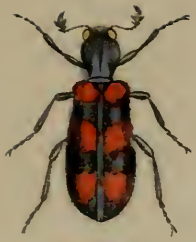


Fig. 2

Fig. 3

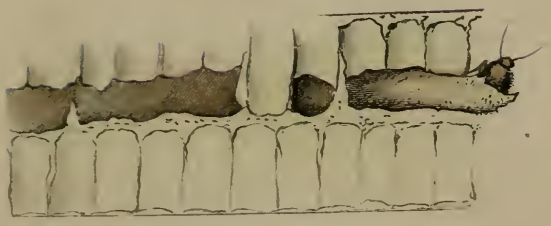


Fig. 4

1. Clerus Apiarius. 2. Tinea Mellonella.
3. gallery of the larva. 4. Humble bees supporting a piece of comb.

Lizars sc

Mewett del.

Lizars sc.

Deaths-head Hawkmoth.

Fig. 1.

Fig. 2.

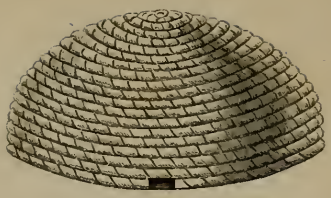


Fig. 3.

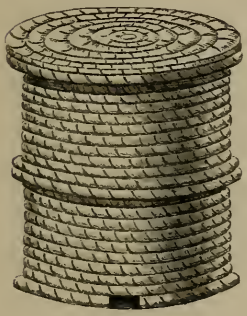


Fig. 4.

Fig. 5.

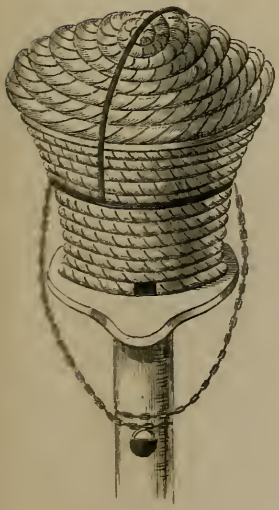
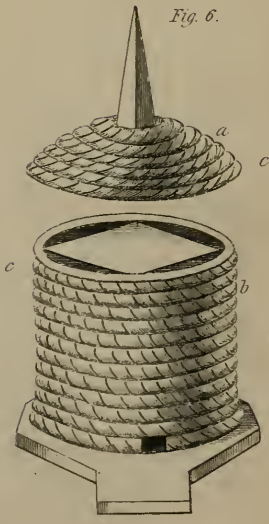


Fig. 6.



Lizars Sc

STRAW HIVES

WOODEN HIVES

Stewart del.

Lizars sc.

Fig. 2

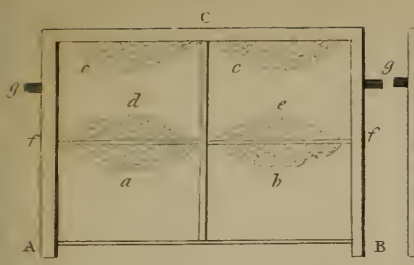


Fig. 1.

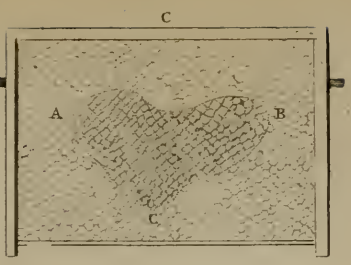
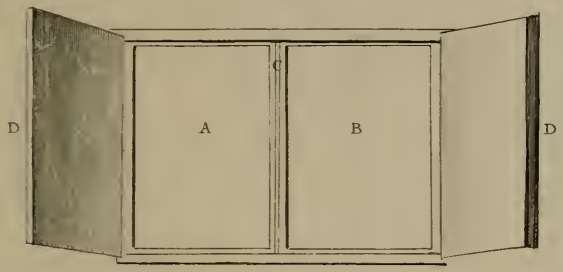


Fig. 4



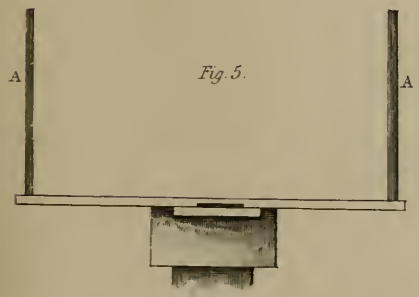


Fig. 5.

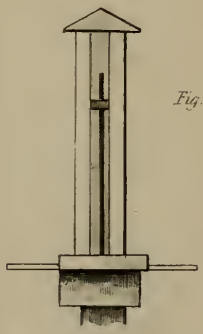


Fig. 7.

Fig. 6.

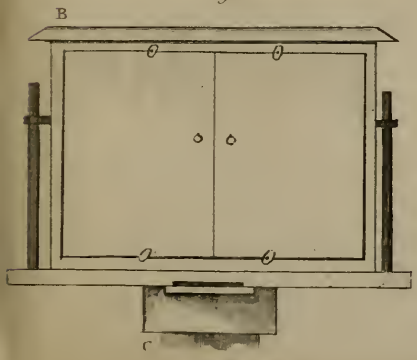
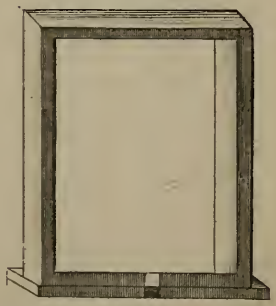


Fig. 3.



Lizars sc

Mr DUNBAR'S EXPERIMENTAL HIVE

Fig. 1.

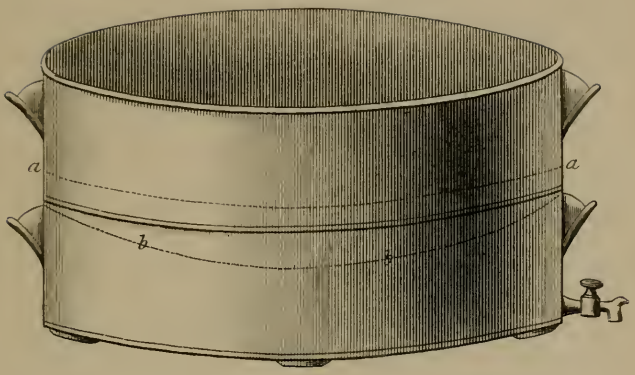


Fig. 2.

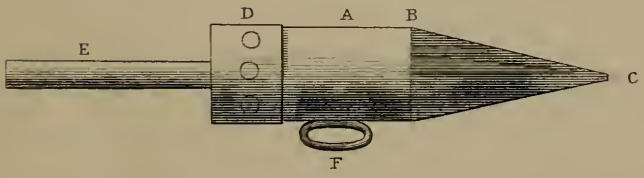


Fig. 3.

1. Honey Drainer. 2 Fumigating Pipe. 3. Feeding Trough.

Common Humble-bee.
(B. terrestris)

Stewart del.

Lizars sc.

Stewart del.

NEST OF THE COMMON HUMBLE BEE (B.TERRESTRIS.)

1 2 Orange tailed-bee. (B. lapidarius)
3. Moss or Carder bee. (B. muscorum.)

1. Donovans Humble-bee. (B. Donovanellus.)
2. Great Humble-bee of Valparaiso. (B. grandis.)

J. O. Westwood del.

Lizars sc.

J.O. Westwood. delt.

1. Harris Humble-bee. (Bombus Harrisellus.)
2. Apathus vestalis. 3. Apathus rupestris.

Lizars sc

1. Euglossa Surinamensis. 2. Euglossa analis. 3. Aglae caerulea

1. *Centris nobilis*
2. *—— grossa.*
3. *Xylocopa violacea*

1. Xylocopa Teredo, male. 2. female.
3. _____ Corniger.

Lizars sc

INTERIOR OF A MEXICAN BEE'S NEST.

Lizars sc.

1. Xylocopa latipes.
2. ——— tenuiscapa.

Lizars sc

Stewart del.t

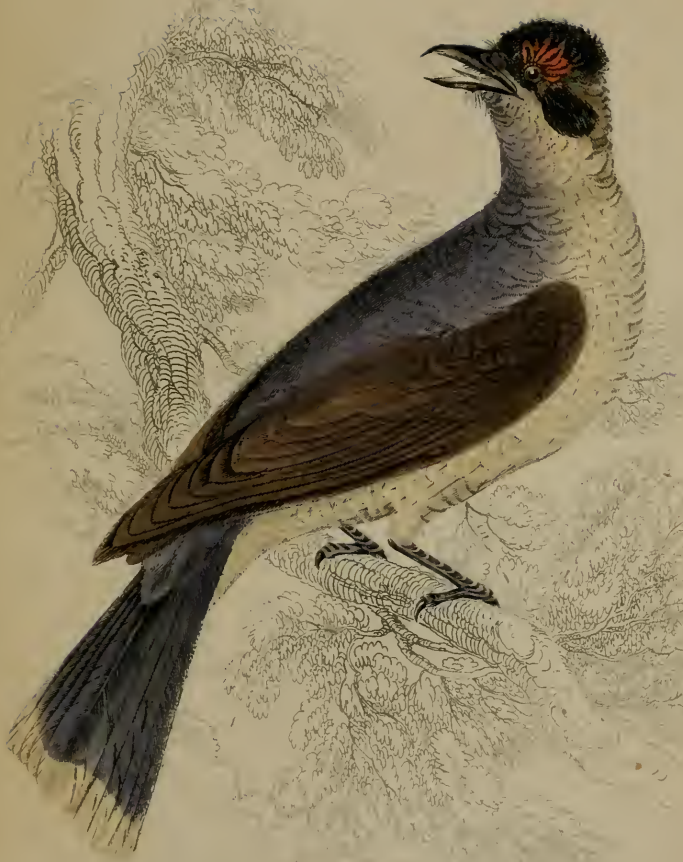
Apis Ligustica.

Lizars sc

HONEY GUIDE

W. F. delt.

Lizars sc.



AMERICAN TYRANT FLYCATCHER.

Stewart del.t

Lizars s

1. *Trigona amalthea*
2. ——— *ruficrus.*
3. *Melipona postica.*
4. ——— *scutellaris.*

Lizars sc.

A.H.B. del.

Lizars sc

NEST OF THE LECHEGUANA.
(Polistes Luè)
With the Insect magnified double its natural size.

HONEY RATTEL

EUROPEAN BEE-EATER

W.J del.t

Lizars sc.